BOTANICAL MUSEUM LEAFLETS

HARVARD UNIVERSITY

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BOTANICAL MUSEUM LEAFLETS
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THE BOTANICAL MUSEUM OF HARVARD UNIVERSITY IN ITS 125th YEAR

1858-1983

The year 1983 marks the 125th anniversary of the founding of the Botanical Museum of Harvard University. It seems, therefore, appropriate to review the present state of the Museum from the point of view of its academic, research and public activities.

The Botanical Museum is one of five institutions at Harvard devoted to the plant sciences, its sister institutions being the Gray Herbarium, the Farlow Herbarium, the Arnold Arboretum and the Harvard Forest. Each is devoted to different aspects of botany. The Museum's fields of activity—economic botany (including several types of ethnobotany), paleobotany and orchidology—are diverse and, in scope, world-wide. They are likewise strongly interdisciplinary in character, basically biological but impinging upon other fields of science and the arts: anthropology and archaeology, chemistry and pharmacology, history, geology, horticulture, to mention only several.

Partly as a result of the wide orientation of the work of the Museum, research by members of its staff and students has attracted attention in fields other than the plant sciences, sometimes in fields distant from botany. It is particularly noteworthy

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that all of the areas of teaching and research in the Museum are marked by this peculiarity of integrating material from and impinging upon several other disciplines.

The Botanical Museum dates from 1858, when Asa Gray wrote to Sir William Hooker, Director of the Royal Botanical Gardens at Kew: "I must tell you in humble imitation of Kew I am going to establish a Museum of vegetable products, etc., in our University." Hooker sent over duplicate economic botany materials from Kew, and these became the nucleus of a collection that grew in a somewhat desultory manner until 1878, when its care was added to the many other duties of Professor George Lincoln Goodale. Goodale saw this as the "germ of something large and fine"* and felt "...that such an assemblage, freed of casual elements and constructively developed along economic lines, might function both as illustrative material for the teacher and as a reference collection to which even the specialists might turn for much-needed information—a place where rare drugs could be identified or unusual fibres compared."*

The University named Goodale first director of the Botanical Museum in 1888, and the building of the Museum was completed under his direction in 1890. The period of active life of the Museum dates actually from the naming of its first director. Not the least unique aspect of this active life was the creation from 1887 through 1936 of the widely known Ware Collection of Blaschka Glass Models of Plants which constitutes today, in addition to its basic function as an adjunct in teaching botany, the major public attraction in the University.

Over its century and a quarter history, the Botanical Museum has grown into one of the world recognized centres of research in the plant sciences. Yet its reputation has developed differently from that enjoyed by many other outstanding botanical institutions, in part because the Museum's research, exploration and teaching, both university and public, are interdisciplinary in nature, transcending the usual strict boundaries of the plant sciences. During the past half century, these aspects of the Museum's activities have enjoyed an especially steady develop-

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*Samuel Eliot Morison (Ed.) "The development of Harvard University, 1869–1929," Harvard University Press, Cambridge, Mass. (1930).

ment and expansion with the impetus given by the second and third directors of the Museum, Professor Oakes Ames and Professor Paul C. Mangelsdorf, respectively.

Research

Research is a major keynote of the Museum's philosophy. It is carried out not only in the laboratory, herbarium and library, but also in the field. Every aspect of the Museum's research involves field work or extensive exploration in a great variety of regions, including Mexico, the Andes and Amazonian parts of South America, Greenland, Canada, South Africa, Australia, Afghanistan, to name only a few of the areas where the staff and students have worked. It has also involved research in agricultural experimental fields. Lastly, certain aspects of its research have concerned historical and archaeological aspect of ethnobotany.

Teaching

The Museum's teaching activities have materially enriched the course offerings in Harvard's Department of Biology on both the undergraduate and graduate levels. Recent courses by its staff have introduced students to the complexities of evolution of crop plants, paleobotany and the evolution of plant life through geological time. The country's oldest course in economic botany, currently known as "Plants and Human Affairs," has strongly influenced many of its students who have continued in academia, in science, in industry and in medicine. Numerous courses in various specialized phases of economic botany and the effect of plants on history have during the past twenty years been offered to the public in Harvard's Commission on Extension. The course "Plants and Human Affairs" has also been taught on several occasions in Harvard's Summer School program and advanced courses in medical botany have, until recently, been part of the offerings of the Department of Biology.

Graduate student doctoral research supervised by the Museum staff has encompassed a wide spectrum of topics in paleobotany (Precambrian evolution of life, Pleistocene vegetation patterns in Eastern North America and Central America, the anatomy of Tertiary woods and fruits), economic botany (ethnoecology of Amazonian and Mexican tribes, generic monographic treatments of economic plants of tropical America, ethnobotany of Andean Indians, biological studies of maize and its relatives) and in orchidology.

Exhibits

One purpose of a museum is public service, providing a link between specialists and the public. In this activity, the Botanical Museum has excelled throughout most of its century and a quarter of existence. Although devoted primarily to university teaching, its exhibits have always been open to the public. Although now drastically limited, due to recent severe space restrictions, they still continue to draw more than 100,000 visitors a year from all parts of the world. Millions know the Museum as the home of the "Glass Flowers," officially called the Ware Collection of Blaschka Glass Models of Plants. Another exhibit presents pioneering research carried out by the Museum staff and students on Pre-Cambrian plants variously dated at from 3,000,000,000 to 3,400,000,000 years of age.

Until recently, two rooms housed extensive exhibits of economic plant products (including a large collection of ambers and Chinese laquer-ware), and an entrance hall presented displays of ongoing Museum research on the origin and biology of maize, on archaeoethnobotany and on narcotic and hallucinogenic plants of the New World. These widely acclaimed exhibits were unfortunately dismantled due to a reshuffling of space and its loss to the Botanical Museum.

Economic botany: ethnobotany

The Museum's oldest field of interest, going back to the very founding of the Museum in 1858, is economic botany which is at present based on several unique collections, especially on the Laboratory of Economic Botany with its collection of economic plant products and herbarium of economic plants and on the

Economic Botany Library of Oakes Ames, comprising over 30,000 titles.

The term, economic botany, has always been broadly interpreted in the Botanical Museum to signify interdisciplinary studies on plants useful or harmful to man: consequently included are not only those plants of value to our modern agricultural and industrial civilization but also the often complex relation of primitive or pre-literate cultures to their ambient floras.

The introductory course in eonomic botany—"Plants and Human Affairs"—has been taught since 1876 and is now offered annually to graduate and undergraduate students of Harvard University and Radcliffe College. The most widely used textbook in this field—Hill's *Economic Botany*—was written at the Museum by a member of the staff and is based on the current Museum's collections and library. Throughout its history, various workshops, symposia and seminars in topics in economic botany have been held in the Museum and, under the sponsorship of the Museum, in South America.

Studies in economic botany in the American tropics have been extremely constant and productive. Of special and novel interest has been the ambitious search through the 4,500,000 specimens in the Harvard University herbaria for collector's notes on the native uses of foods and medicinal plants—research which has resulted in an extremely successful book.

Investigations into the economic botany of numerous commercially important groups of plants have characterized much of the Museum's recent effort: Hevea and other rubber-producing plants; Brugmansia, Erythroxylon, Theobroma, Cannabis, to name only several.

One major aspect of economic botany has been the extensive archaeological, morphological, taxonomic and genetic research on the origin of cultivated plants, especially maize, in the studies of which a unique group of scientists spent over a quarter of a century investigating the origin, evolution, structure, history and other aspects of this major cereal, including research on remains of primitive maize from Mexico and South America. Furthermore, advanced courses have been offered on the origin of other cultivated plants.

Ethnobotany, or the study of the relationship of plants and primitive societies, has played a significant role in the Museum's economic botany programme. During the past fifty years, intensive ethnobotanical studies have been carried forth, especially in tropical America. These have encompassed field and laboratory investigations in ethnopharmacology, ethnoecology, ethnomycology and archaeoethnobotany, concentrating particularly in the study of medicinal, narcotic and toxic plants. The investigations have been carried out primarily in Mexico, Colombia, Ecuador, Brazil and Peru, although the research in ethnomycology has been much wider.

Since the 1930's, one of the specialized branches of ethnobotany that has been seriously pursued is ethnomycology—the relationship of fungi and human affairs. Research in this field has been carried out in the United States, Mexico, Japan, India, and Europe.

The Museum's facilities in archaeoethnobotany—the study of archaeological plant remains and their significance to both plant evolution and man's social and cultural evolution—have attracted scholars from far and wide. The research in archaeoethnobotany has been especially focused on Peru and Mexico, particularly on specific crop plants such as maize, including the origins of agriculture in these countries. This effort has led to the creation of an extensive study collection of archaeological plant remains, one of the few in the United States, and to the publication of significant books and articles in this neglected field. Recent research on vegetal remains in Egyptian, Peruvian and Aleutian mummies has been a novel undertaking of the Ethnobotanical Laboratory.

The most recent development has been the initiation of active effort in conservation in cooperation with the World Wildlife Fund. An Ethnobotany Specialist Group has been set up to bring together ethnobotanists from around the world in the realization that folklore concerning plants and their uses is fast disappearing with the encroachment of civilization. This programme is a logical extension of the Museum's longstanding ethnobotanical activities.

Paleobotany

Another long established part of the Museum is the Laboratory of Paleobotany. The collection of fossil plants, constituting one of the most valuable of the world because of its wealth of type specimens, has been the basis of research in plant evolution for nearly a century. Linking botany and geology, Harvard's paleobotanical research has in recent years studied the oldest forms of life yet discovered, some specimens dated at more than three billion years of age.

The staff and students of the Laboratory of Paleobotany have been active in field work in sundry parts of the world: North America, Greenland, South Africa, Australia.

The Bailey-Wetmore Laboratory of Plant Anatomy and Morphology

Although the Wood Collection, basis of the Bailey-Wetmore Laboratory of Plant Morphology and Anatomy, is not exclusively a part of the Botanical Museum, it is housed in the museum. This facility represents the union of wood samples from the Biological Laboratories, the Gray Herbarium, the Arnold Arboretum, the Harvard Forest and the Botanical Museum—the second largest scientific wood collection in the United States. It is under the direction of a committee of representatives of the several institutions.

Orchidology

The Orchid Herbarium and Library of Oakes Ames, comprising a collection of more than 100,00C herbarium specimens and many thousands of spirit collections of orchids from every continent and an associated library of some 5,000 titles, represents the world's largest herbarium devoted to a single plant family. Originally dedicated mainly to purely taxonomic and floristic research, its importance to wider fields of research has recently been established in such disciplines as cytology, genetics, phytochemistry, phytogeography and horticulture. Members of the staff of the Orchid Herbarium have, during the past half century or more, carried out exploration in many parts of both hemispheres, especially in the tropics.

Although the staff of the Orchid Herbarium is concerned primarily with taxonomic and floristic investigation, it offers valuable consultative services to orchidological horticulture.

The Economic Botany Library of Oakes Ames

This unique library of some 30,000 titles is topically indexed to uses of plants as well as to names of plants. Basic to the teaching of various aspects of economic botany, it is organized especially for student use. It is, however, a research tool of extreme importance, consulted by students and scholars from mmany fields at Harvard and by researchers from other universities in the greater Boston area. It is completely interdisciplinary in scope, organization and aims.

The Tina and Gordon Wasson Ethnomycological Collection

Given to the Botanical Museum by Dr. R. Gordon Wasson and dedicated in February, 1983, this collection represents the only facility in the world set up specifically for research in the history and influence of fungi in human affairs. It is basically an interdisciplinary library of approximately 8000 titles, including sundry items in foreign languages that are not often found in this country and numerous valuable rare herbals and other volumes published in medieval Europe.

Associated with the library is a collection of art and archaeological artifacts: carvings of mushrooms in jade, ivory, bone and wood from Asia; stone "mushroom gods" from Guatemala, some dated approximately 600 B.C.; a 2000-year-old Mexican shaman communing, with her hand on a large mushroom; Japanese and Chinese paintings; posters; drawings; American Indian documents; and other objects.

This collection is available to research scholars whose interests lie in studies of the role that fungi have played in civilization.

Publications

The BOTANICAL MUSEUM LEAFLETS OF HARVARD UNIVERSITY, now in its 29th volume, has been a major outlet for the scientific papers of its staff and students. Printed until recently on our own press, it has published papers of worldwide interest with many novelties and discoveries in orchid taxonomy, new genera and species of tropical America, origin of cultivated plants, economic botany, Amazonian ethnopharmacology, ethnobotany, ethnomycology, phytochemistry and paleobotany. The staff has likewise published over the years a large number of books in these fields, a number out of all proportion to its small size. Especially notable is the production of books in orchidology, for the orchid floras of a large percentage of New World countries have been the products of the Botanical Museum: North America, Trinidad and Tobago, Mexico, Guatemala, Venezuela, Ecuador, Peru, lesser Antilles and Okinawa.

Commemorative Events During 1983

During this 125th year of the Botanical Museum, several events in recognition of the anniversary have been planned and carried out. In February, the Tina and Gordon Wasson Ethnomycological Collection was dedicated. The halls and cases where the Glass Flowers are exhibited were air-conditioned for control of humidity to safeguard the models, some of which are nearly a century old, from dust and deterioration. The first extensive book on the Glass Flowers, illustrated with 85 colour photographs of the models and published in December 1982, was made available to the public at the sales desk of the Museum.

The Botanical Museum is a small institution, yet its influence has spread far and has been felt in many circles, primarily because of the interdisciplinary character of all of its teaching and research. It proudly takes its place among the institutions dedicated to the advancement of botany around the world.

THE STAFF OF THE BOTANICAL MUSEUM IN 1983

Richard Evans Schultes, Ph.D., M.H.(hon.), Jeffrey Professor of Biology; Director; Curator of Economic Botany.

Paul C. Mangelsdorf, Ph.D., Fisher Professor of Biology Emeritus; Director Emeritus.

Elso S. Barghoorn, Ph.D., Fisher Professor of Biology, Curator of Paleobotanical Collections.

Leslie A. Garay, Ph.D., Curator, Orchid Herbarium of Oakes Ames.

Andrew H. Knoll, Ph.D., Associate Professor of Biology.

Howard J. Allgaier, Printer.

William A. Davis, M.A., Keeper of Scientific Exhibits.

Mary R. Gaudet, Staff Assistant.

Katheryn M. Harrow, Staff Assistant.

Scott E. Wilder, B.A., Curatorial Assistant.

Doris E. Ward, Typist - Secretary.

Wesley Y.Y. Wong, M.A., Library Assistant.

ADJUNCT APPOINTEES

Loran C. Anderson, Ph.D., Associate in Economic Plants.

Michael J. Balick, Ph.D., Associate in Plant Domestication.

Umesh C. Banerjee, Ph.D., Associate in Palynology of Cultivated Plants.

Elizabeth A. Coughlin, M.L.A., Associate of Botanical Museum.

G.C.K. Dunsterville, B.S., Associate in Orchidology.

William A. Emboden, B.S., Associate in Ethnobotany.

Norman F. Farnsworth, Ph.D., Associate in Ethnomedicine.

Alvaro Fernández-Pérez, Quim. Farm., Associate in Medical Botany.

Thomas T. Furst, Ph.D., Associate in Ethnobotany.

Francis W. Hankins, M.E., Associate in Paleobotany.

Fritz H.P. Hamer, Associate in Orchidology.

Bo Holmstedt, Docent M.D., Associate in Medical Botany.

Dorothy A. Kamen-Kaye, A.B., Associate in Ethnobotany.

Mark J. Plotkin, M.F.S., Associate in Ethnobotanical Conservation.

Timothy C. Plowman, Ph.D., Associate in Ethnobotany.

Robert F. Raffauf, Ph.D., Associate in Medicinal Plant Chemistry.

Siri von Reis, Ph.D., Associate in Ethnopharmacology.
Frederic Rosengarten, A.B., Associate in Economic Botany.
Judith Schmidt, Ph.D., Associate in North American Ethnobotany.
Gunnar Seidenfaden, D. Phil., Associate in Orchidology.
Emly Steffan Siegerist, B.A., Associate in Orchidology.
John E. Stacy, M.A., Associate in Orchidology.
Tony Swain, Ph.D., D. Sci., Associate in Phytochemistry.
Herman R. Sweet, Ph.D., Honorary Curator of the Oakes Ames Orchid Herbarium.
Margaret A. Towle, Ph.D., Associate Curator of Ethnobotanical Collections.
R. Gordon Wasson, B. Litt., Associate in Ethnopharmacology.
Andrew T. Weil, M.D., Associate in Ethnopharmacology.
Johannes Wilbert, Ph.D., Associate in Latin American Amerindian Folk Medicine.

Richard Evans Schultes
Jeffrey Professor of Biology;
Director, Botanical Museum

THE PALEOBOTANICAL COLLECTIONS

The Paleobotanical Collections of the Botanical Museum constitute an unusually comprehensive documentation of plant evolution in geologic time. The more than 60,000 specimens in the collections make Harvard the nation's second largest repository for fossil plants in terms of size alone. If one considers completeness of stratigraphic, geographic, and taxonomic coverage, the Botanical Museum collections are without peer. Fossils in the Paleobotanical collections range from simple prokaryotic microfossils preserved in 3400 million year old cherts from South Africa to wooden artifacts discovered in Indian and colonial archeological sites in New England. The collections include materials from all continents (as well as extraterrestrial carbon isolated from meteorites) and all geologic periods. Thus, the Paleobotanical Collections provide unique oportunities for education and research.

THE AGASSIZ INFLUENCE

The name of Louis Agassiz is usually associated with the Museum of Comparative Zoology, but the eminent Swiss paleontologist was also instrumental in the establishment and early growth of Harvard's fossil plant collections. Agassiz immigrated to America in 1847, following the suppression of his home institution, the Academy of Neuchâtel, by the Geneva Revolutionary Council. Fortunately for the development of paleobotany in North America, he soon persuaded his Neuchâtel colleague Leo Lesquereux to join him in America (Darrah, 1934). Lesquereux' deafness prevented him from acquiring an academic position, but in late 1848 he moved to Columbus, Ohio, to aid William Sullivant in his studies of bryophytes—a post that still required Lesquereux to support his family by making watches and

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The delegation of the Botanical Museum in the academic procession of the Commencement, June 1983. From left to right: Professor Loran Anderson, Professor Richard Evans Schultes, Professor Andrew Knoll, Professor Tony Swain, Miss Elizabeth Coughlin, Professor Robert J. Raffauf.

(Photograph: Stephen Jennings)

jewelry. As Lesquereux' reputation as a bryologist grew, so did his distinction as a student of fossil plants. Lesquereux' research on the Mississippian and Pennsylvanian floras of Pennsylvania and several other states culminated in the publication of his monumental *Description of the Coal Flora of the Carboniferous Formation in Pennsylvania and throughout the United States* (1879–83). This work stands as the first great monograph on American fossil plants, and the specimens described therein thus have particular scientific and historical significance. Because of Lesquereux' association with Agassiz—Lesquereux spent several months each year working on collections at Harvard—many of the *Coal Flora* collections were deposited in the Boston Museum of Natural History, from which they were moved to Harvard in 1892. Darrah (1969) estimated that some 60% of Lesquereux' type and figured specimens from the *Coal Flora* are housed in the Paleobotanical Collections of the Botanical Museum; most of his later collected types reside in the United States National Museum.

Lesquereux' interest in fossil plants was not restricted to the Carboniferous System; he collected widely in the Cretaceous and Tertiary beds of the United States, and much of this material is also housed in the Botanical Museum.

Other collectors also contributed to the early growth of Harvard's paleobotanical collections. Agassiz was responsible for bringing much now classic material to Cambridge from Europe, and the combined talent of Agassiz and Lesquereux made Harvard an attractive place to deposit many of the important fossil plant collections that were being discovered in the latter half of the nineteenth century. The list of collectors who donated fossil plant specimens to the Agassiz Museum includes many of the great names in paleontology: men such as Walcott, Bronn, Dawson, and Lyell. Some 800 beautifully preserved specimens collected by Oswald Herr from the Miocene lake beds of Oeningen, Switzerland, were deposited in the Museum, and more than 2000 fossils from the Cretaceous Denver and Dakota groups were identified by Lesquereux from material collected by Arthur Lakes and Charles Sternberg.

In sum, the magnet of Agassiz' fame and the prodigious work of Leo Lesquereux together provided the foundation for the Paleobotanical Collections. These early collections include rare materials from Europe that are not available elsewhere in the United States as well as many of the Lesquereux Coal Flora specimens, an assemblage that as much as any qualifies for the title of America's "type" paleobotanical collection.

THE PHANEROZOIC COLLECTIONS

The Botanical Museum was established in 1858. Forty six years later, the Paleobotanical Collections were formally instituted as a part of the Museum. The new collections brought together material previously housed in the Museum of Comparative Zoology and the extensive collections of the Boston Museum of Natural History. Many of these collections, including those of Lesquereux, were poorly curated and catalogued. Robert Tracy Jackson, a respected zoologist specializing in the study of echinoderms, undertook the task of curating these collections, and it is because of his effort that these important fossils are available for continued study today.

The Paleobotanical Collections expanded upon their already formidable base in the closing years of the nineteenth century and the early decades of the twentieth through the acquisition of several major collections and numerous smaller ones. Important gifts of this period include a diverse suite of European fossils donated by E.C. Lee, a large collection of Miocene plants from the Latah Formation of Washington contributed by E.E. Alexander, the Schary collection of Devonian plants from Hostin, Bohemia, and the Rogers collection of material from Triassic and Jurassic localities in Virginia, North Carolina, and the Connecticut Valley.

Carboniferous plants remained central to the research activities of paleobotanists associated with the Museum. Of particular importance is the Lomax Collection, a selection of some 300 thin sections of coal balls cut by the British lapidary James Lomax and acquired by E.C. Jeffrey. These sections display the anatomy of Carboniferous plants with unrivaled clarity, and many are of special significance in that they were cut from fossil surfaces immediately adjacent to those used by D.H. Scott to illustrate his classic text *Studies in Fossil Botany* (1900). Much new Pennsylvanian material was also added to the collections during the tenure of William Darrah as curator from 1936 to 1941. In addition to his own extensive collections, Darrah arranged exchanges for European materials identified by Jongmans and Bertrand and acquired a large collection of the famous Mazon Creek nodules collected by Frederick Thompson, a long-time friend of paleobotany and a Research Fellow in the Museum. Several thousand coal ball peels were prepared and identified during this period, many of them by a young Harvard graduate student named Elso Barghoorn, and these continue to play an important role in paleobotanical teaching in the Department of Organismic and Evolutionary Biology. More recent additions to the Museum's Carboniferous collections include materials from the Pennsylvanian of New England deposited by John Oleksyshyn, Paul Lyons and colleagues, Clifford Kaye, Edward Grew and C.E. Grant. A newly acquired assemblage donated by Henry L. Barwood documents Pennsylvanian floras from the Warrior Basin of Alabama.

Other additions to the Paleobotanical Collections have included a varied suite of fossils particularly rich in Triassic specimens from Arizona donated by Lyman Daugherty, an extensive collection of beautifully preserved Middle Devonian plants presented to the Museum by Raymond Baschnagel, and an unrivalled collection of Cretaceous and Tertiary fossil woods donated by the late Frank Hankins, a Research Fellow in the Museum. The petrified wood collection includes several thousand geographically widespread specimens and constitutes a major source of information on angiosperm wood evolution that has yet to be fully investigated. These collections have been added to the Paleobotanical Collections during the curatorship of Elso S. Barghoorn, Fisher Professor of Natural History. During his 36 years at Harvard, Professor Barghoorn has increased the collections not only through the acquisition of gift materials but also through his own extensive field work. Of particular importance is material of the Brandon Lignite, Vermont, collected in several expeditions during the period 1947–1977 by Barghoorn and his students Alfred Traverse, William Spackman, and Bruce Tiffney.

The coal collections at Harvard are appropriately maintained as part of the Paleobotanical Collections. The basis for this collection is a large suite of materials acquired by E.C. Jeffrey, whose innovations in coal petrology led to an increased understanding of the origin of coal (Jeffrey, 1925). Knowledge of the origin and constitution of coal and related sediments is fundamental to coal utilization in technology. The petrographically determined botanical composition of coal is closely related to its coking properties and gasification behavior. Although coal science *per se* is not now part of research activities in the Paleobotanical Laboratories, the collections at Harvard have provided part of the background for research programs in both government and industry and for graduate students who have become leaders in coal research. The Jeffrey collections have been supplemented through the years, especially by the addition of specimens collected by Barghoorn. Today, the collections include several thousand samples, thin sections, and macerations, representing most of the major coal basins of the world.

THE PRECAMBRIAN COLLECTIONS

For the past thirty years, the Paleobotanical Laboratories have been closely identified with research on the early evolution of life, and because of this, the Precambrian paleontological collections have achieved a size and importance that justifies their discussion in a separate section.

The earliest acquisition of Precambrian materials by the Botanical Museum was in 1937, when a collection of fossil calcareous algae, stromatolites, and pisolites was purchased from C.L. and M.A. Fenton. Although much of this material is Phanerozoic in age, some of the stromatolites come from the Middle Proterozoic Belt Supergroup in Montana. These and all other presumed Precambrian fossils were at the time considered to be little more than poorly understood curiosities. A new perspective on early evolution emerged in 1952 when Stanley Tyler, an economic geologist from the University of Wisconsin, contacted Barghoorn concerning structures resembling microorganisms that he had observed in petrographic thin sections of the 2000 million year old Gunflint Iron Formation, Ontario. (Tyler and Barghoorn had already begun to collaborate on the investigation of a 2000 million year old coal from the Michigamme Formation of Michigan—surely one of the rarest items in the Coal collections.) Barghoorn confirmed the structures as microfossils, and in a subsequently published report (Tyler and Barghoorn, 1954), the two scientists quadrupled the known length of the fossil record and ushered in a new era of paleobiological research on the earth's most ancient rocks. Barghoorn and Tyler made several collecting trips to the Gunflint in the 1950's, and since that time further collections by Barghoorn and his students have increased both the size and comprehensiveness of Harvard's Gunflint collection. Upon the death of Stanley Tyler in 1963, his entire collection of Gunflint thin sections was given to the Paleobotanical Collections. The Harvard Gunflint collections include carbonaceous shales, stromatolites, anthraxolites, and other associated sedimentary rocks, as well as fossiliferous cherts, and they continue to serve as source material for paleobiological and geochemical research.

The Gunflint provides the historical nucleus of the Precambrian collections, but numerous additional research projects involving Barghoorn and his students have increased the scope of the collections tremendously during the past two decades. The collections now include material ranging in age from the Isua Supracrustal rocks, at 3800 million years old the oldest known rocks on earth, to the base of the Cambrian Period. Some 70 formations from six continents are represented. In addition to the Gunflint Formation, highlights include some of the oldest fossiliferous material known, microfossiliferous cherts from the 3400 Ma old Swaziland Supergroup, South Africa, and the original collections of the important Late Precambrian biota of the Bitter Springs Formation, Australia. Collections made by A.H. Knoll in the Late Precambrian sequences of Svalbard and East

Greenland are unrivalled for their paleoenvironmental comprehensiveness and their high degree of stratigraphic and paleoecological control. These collections also include a large number of planktonic fossil assemblages prepared from Late Precambrian rocks of the Arctic, Australia, Europe, the Soviet Union, Africa, and North America, including, curiously, some from Cambridge, Massachusetts.

Type materials include those from the Gunflint, Bitter Springs, Fig Tree, Skillogalee, Narssârssuk, Draken, Hunnberg, and Ryssö formations.

ASSOCIATED COLLECTIONS

THE POLLEN COLLECTION. Palynology is the study of pollen, spores, and other organic microfossils. Long recognized as an important tool in stratigraphic studies, palynology is now employed in a wide variety of paleobiological and paleoclimatic investigations as well. The Harvard Pollen collections constitute a reference collection documenting the pollen and spores of some 11,000 species of extant vascular plants. Although species represented come from many parts of the globe, the collection is especially rich in tropical American and Chinese material. These collections are currently used in basic research in palynology and have provided source materials for several Ph.D. theses completed at Harvard. Fossil pollen and spore collections are also included in the Pollen Collection; most notable among these are material from the Oligocene Brandon Lignite prepared by Alfred Traverse and Holocene pollen and spores from Gatun Lake, Panama, described by Alexandra Bartlett.

THE WOOD COLLECTION. The wood collection, approximately 30,000 specimens, and the wood microscope slide and other anatomical collections (ca. 30,000) constitute a large informational reservoir concerning plant structure. The wood sample collections are also of potential use in studies of the physical properties of woods and their chemical composition. Although no program of instruction or research in wood technology is now offered, the collections are available and curated for such potential utilization.

THE FRUIT AND SEED COLLECTION. Like studies of fossil pollen and wood, systematic investigations of fossil fruits and seeds necessitate a reference collection of modern materials. A large collection of mature reproductive organs of both gymnosperms and angiosperms is maintained as a separately curated resource for paleobotanical studies. Though world wide in coverage this collection is especially rich in material from tropical America and southeastern Asia. The collection is comprehensive with respect to the flora of the Isthmus of Panama and lowland Costa Rica.

CONCLUSION

The Paleobotanical Collections are a comprehensive and well curated resource for research and teaching in the comparative morphology and anatomy of vascular plants. As they have for many decades, the collections provide a focus for Harvard courses on plant evolution in geologic time. They also continue to provide research materials for faculty and students in residence at the Paleobotanical Laboratories, as well as visiting scientists—not only paleobotanists but, increasingly, also geochemists. The several hundred type specimens ranging in age from Precambrian to Quaternary retain their importance as standard paleobotanical references. We can only conclude by reiterating our opening statement: the Paleobotanical Collections of the Botanical Museum constitute a unique source of scholarly information on the evolution of photosynthetic organisms.

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Andrew H. Knoll
Associate Professor of Biology

and

Elso S. Barghoorn*
Fisher Professor of Natural History
and
Curator of Paleobotanical Collections

Deceased, January 22, 1984.

THE BAILEY-WETMORE LABORATORY OF PLANT ANATOMY AND MORPHOLOGY

In 1933, Professors Irving W. Bailey and Ralph H. Wetmore of Harvard University decided to coordinate their future research efforts in comparative plant anatomy and to pool their botanical collections (mostly wood) with those of the late Professor Edward C. Jeffrey. Professor Jeffrey had been internationally recognized for his technical skill and pioneering research into the anatomy of vascular plants, which culminated in his textbook, *The Anatomy of Woody Plants* (1917). Jeffrey also had applied his extensive knowledge of paleobotany and plant anatomy to the complex problem of the botanical and geological origins of coal (Jeffrey, 1924). Later he expanded this into a more popular but nevertheless comprehensive book entitled *Coal and Civilization* (1925).

Bailey and Wetmore, among other notable twentieth century botanists, had studied plant anatomy with Jeffrey and shared his conviction that comparative anatomy was a fundamental and indispensable subdiscipline within the broad context of Plant Biology. They therefore initiated a wood collection for the Department of Biology (Wetmore, personal communication, 1983), in the hope that it would provide information on wood anatomy, which might prove valuable to botanists with diverse research and teaching interests. Bailey and Wetmore displayed extraordinary foresight in their belief that a study of the comparative anatomy of woody plants often helps to unravel complex problems in the evolutionary history and phylogeny of many groups of plants and thus might contribute towards classification of woody plants into "natural" groupings of species, genera, families and orders. Fifty years later, the study of comparative anatomy maintains this fundamental relevance to diverse facets of plant biological, evolutionary and systematic research.

The task of fund-raising for this effort fell largely to Wetmore, who received support from various sources within the University. The Department of Biology allocated space and cabinets for the collections and provided funding for several years, with partial support from the Arnold Arboretum and various granting agencies. Most of the money, however, was provided by the Milton Fund. Professor Samuel J. Record of the Yale School of Forestry also assisted the fledgling Harvard collection by purchasing duplicate microslides for the wood collection which Yale at that time possessed. Bailey, Wetmore and Record enjoyed a long collaboration during the growth of their respective collections which accelerated and stimulated the development of wood anatomy as a modern botanical discipline in the United States.

Collecting expeditions to Cuba and Panama by Wetmore and several of his students further expanded the wood collection, as did later expeditions to temperate and tropical regions by other botanists who provided both wood and voucher herbarium specimens for Harvard's growing collection. By 1940, the collection included over 22,400 microscope slides of wood thin-sections and macerations, as well as some 15,000 wood samples of more than 9,000 species, 280 genera and 267 families of gymnosperms (conifers/"softwoods") and angiosperms (flowering plants/"hardwoods"). As plant structural and evolutionary research progressed, Bailey, Wetmore, Record, and their students and colleagues continued to deposit additional specimens and microscope slides in both the Harvard and Yale wood collections.

These institutional facilities have since played a vital role in both botanical and wood technological research, and continue to serve as indispensable sources of information not only on wood and its properties, but also about plant-structural adaptation and evolution. Bailey, Wetmore, Record and their graduate students were perhaps the most prolific and influential of the early 20th century American wood scientists, both through their research and teaching efforts. Bailey and Wetmore are well known for their pioneering research into applications of wood anatomy to problems of plant evolution and classification, whereas Record's unequalled contributions were largely to the identification and commercial utilization of temperate and tropical woods.

During the past century and a half, specimens of wood had been accumulating in the Gray Herbarium, the Arnold Arboretum, the Botanical Museum and the Harvard Forest. In 1940, it was decided to unite all of this material with that collected in the Department of Biology by Bailey and Wetmore. Initially this collection was housed in the Biology Laboratories, but in 1955 it was moved into the newly completed Harvard University Herbaria at 22 Divinity Avenue. During the summer of 1973, the wood collection was moved into a completely renovated area in the basement of the Botanical Museum, adjacent to the Museum's Paleobotanical Collections which include the extensive Hankins Collection of Fossil Forests (woods). This was largely the result of the efforts of Research Assistant Elisabeth Wheeler and graduate student Bruce Tiffney. On January 7, 1974, the President and Fellows of Harvard College approved the establishment of the Bailey-Wetmore Laboratory of Plant Anatomy and Morphology, as the facility in which the Harvard Wood Collection is housed. Professor Elso S. Barghoorn was designated as the Supervisor of the collection and an informal advisory committee was formed, including representatives of the several institutions involved in the development of the collection.

Today, Harvard's Wood Collection contains over 30,000 specimens of more than 300 woody plant families as well as some 35,000 microscope slides of wood and an additional 15,000 micro-slides of stems, leaves, flowers and pollen. These collections are of diverse geographic origin, with especially strong representation for tropical Asia, Australia and the Americas. Most woods have been processed into micro-slides and 60–70% of these collections are documented with herbarium specimens in the Harvard University Herbaria or elsewhere.

The collection serves the international scientific community, as a source of wood samples with matching microscope slides, which can be used in not only botanical and wood technological investigations but also in archeological, ethnological, ecological, fine arts and forensic research.

Archeologists and ethnologists often must identify wooden objects to understand the uses of plants in past and present cultures. Wood anatomy and growth rings of trees not only may reveal the identity of the species, but also reflect the ecological conditions experienced by the individual tree from year to year. Even disease and insect attacks on trees are recorded in their wood, as traumatic tissues which are easily detected. In many cases, the mineral content of the wood reflects the nature of the soil in which the tree grew: silica (sand) grains in the wood of trees from sandy, siliceous soils; calcium oxalate crystals in trees from limestone (i.e., calcium carbonate) soils; and aluminum compounds in wood grown in aluminum-rich (bauxite) soils. Hence, the study of wood structure can provide the archeologist, botanist and ecologist with information about the climatic and edaphic history of a particular region or site.

Since trees of the temperate zones of the world normally produce a single growth increment annually, a tree's age can be determined easily from its rings. The bristlecone pine (*Pinus aristata*) of the Rocky Mountain region may reach an age of 4,000 years: growth rings thus provide both a calendar and climatic record for historic and prehistoric times. Cross-matching of the rings (of known age) with those of archeological timbers (dendrochronology), can serve to estimate the age of these timbers and the sites from which they were unearthed. Other non-botanists who benefit from the wood collection are cabinet makers, carpenters, museum conservators and fine arts professionals, who can use wood anatomy not only to identify and authenticate wooden objects, but also to understand the chemical and physical nature of various woods, and thus take appropriate measures for their preservation.

The value of the wood collection to commerce also is appreciable. Although there are over 40,000 woody species of flowering plants (hardwoods) in the tropics, only some 600 are internationally traded and of these only 20 or more species constitute more than 90% of all commercial exploitation of wood. Since the anatomy of wood determines its physical and mechanical properties and limitations, it indirectly determines the utility and commercial value of wood species as a timber resource. Hence, the Harvard Wood Collection represents a valuable (although largely untapped) facility to the timber and wood products industries, as a repository for both samples of and information about lesser known species of wood with previously unexploited commercial potential.

Current curatorial projects in the wood collection include the cataloguing and addition of the Charles Sprague Sargent collection, made for the 10th Census of North American Forest Trees, which was completed for the United States Forest Service in 1884. This exquisite collection includes over 1200 uniformly sized and highly polished wood blocks representing 412 species of North American forest trees. Sargent's collection is an excellent teaching aid and source of material for various research problems in botany, forestry, wood science and technology. These woods and data about their origin and physical properties have been included in a monographic forest census published by Sargent in 1884. Ironically, it appears that no researchers in botany, forestry, or wood technology have made much use of this priceless wood collection.

Another curatorial project now underway is the collection of both wood and voucher herbarium specimens from plants cultivated at the Arnold Arboretum. The Harvard Wood Collection already includes over 400 such specimens gathered prior to the 1940's by various botanists. This continuing program will provide a repository for plants which have been removed from the Arboretum's living collections; while assembling unique research material with which botanists can compare the anatomy of many unrelated plants native to diverse habitats and geographic regions throughout the world but growing under the same ecological conditions. Such studies are needed to help distinguish between plant structural features which are determined genetically and those induced by environmental conditions.

ACKNOWLEDGEMENTS

I am deeply indebted to Professor Ralph H. Wetmore for sharing his memories of Botany at Harvard throughout the past fifty years, which both inspired this article and insured its historical accuracy. I also wish to thank P ofessors Elso S. Barghoorn and Richard Evans Schultes for their encouragement and helpful editorial comments.

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Phillip M. Rury
Atkins Research Fellow in Economic and Tropical Botany; Curatorial Assistant, Harvard Wood Collection

THE ORCHID HERBARIUM OF OAKES AMES

A commitment to orchid culture, or rather the "must" of possessing a living orchid collection, is well known to have been a top priority on the list of desiderata of the aristocracy of England and Europe during the 19th Century. This infectious charm of the period, which dominated especially the Victorian era, quickly extended its presence to the New World, where, among others, North Easton, Massachusetts, was a logical place for it to take up a new residence.

The success of this transatlantic migration is clearly written in the pages of horticulture: *Cypridedium Amesianum, Laelia Amesiana, Phalaenopsis,* F. L. Ames, *Laelia anceps* var. *Amesiana, Luisia Amesiana,* to mention a few. All of these orchids commemorate the Honorable Frederick Lothrop Ames of North Easton, Massachusetts: "a zealous cultivator", . . . "a liberal patron of horticulture and the possessor of one of the finest collections of orchids in North America", writes Reichenbach. However, orchids were grown not only by Frederick, but also by other members of the Ames family, including his cousin, Oliver, Governor of Massachusetts, 1886–88. Oakes Ames, son of Oliver, was born into such an environment in 1874.

Oakes's interest in plants, wild flowers and orchids, starting in his childhood, has been told many times in various biographical sketches. His total commitment to the scientific study of orchids, however, took place on October 20, 1898, when he prepared his first scientific description and drawings to be published nine days later as *Catasetum arachnoides* Ames in the AMERICAN GARDENING. The result was exciting. Oakes Ames discovered that he could fly. . .and for his enthusiasm only the sky was the limit.

Thus, in 1899, the Ames Botanical Laboratory was established, according to unpublished notes by Professor Ames, for the study of botanical problems and for original research. The nucleus of this new institution was a carefully assembled collection of orchid specimens. As a matter of fact, the preparation of an orchid herbarium had been started by Oakes Ames in 1889, when he was only 15 years old. At that time, in addition to samples of native orchids, he painstakingly prepared pressings of single flowers of exotic orchids which he collected from the greenhouses of his father and his father's cousin, as well as from other orchid collections, such as the W. W. Lunt collection or those of Henry Graves in Orange, New Jersey. In 1899, the orchid herbarium began to grow rapidly through the active purchase of specimens as well as through material received for identification, especially from the Bureau of Science in Manila, the Philippines.

It has been said repeatedly that no one becomes a true botanist, unless he be born with such a charisma. In retrospect, we may say that the young Oakes Ames not only reflected the marks of a true botanist but was obviously destined to stand as a symbol and inspiration for all future students of orchidology. Although as a member of the faculty, he had access to the rich botanical library of Harvard University, Ames knew the immense advantage of owning a personal reference library. On April 15, 1901, he noted in his journal: "If we really wish to make a study of orchids, we ought to begin with the earliest records, the old herbals, for example." Sparing neither effort nor zeal, Oakes worked steadily to build and enlarge the foundation as well as the structure of his orchidological realm.

By 1904, the orchid collection had grown to a rather impressive size, close to 10,000 sheets. An official count was made in September of that year through the application of a consecutive numbering system within an inscription of "HERBARIUM—OAKES AMES", a system still in use today. Since the herbarium was considered by Ames primarily as a working tool, it became a depository of much and varied information on orchid species in addition to the storage of dried specimens. Included were original descriptions, photographs, drawings of floral details, life size copies of type-specimens, published plates and similar documents which would be of use for identification purposes.

In 1905, while Ames was on vacation, his assistant, Dr. Leavitt, answered in his name a letter which came from the Bureau of Science in Manila asking him to write up the orchid part of a projected flora of the Philippines. Upon his return, Ames was dumfounded by the colossal task that had been undertaken in his name, for his information of the Philippine orchids was indeed pitifully inadequate. His inner strength and clear vision found him literally within 24 hours on board the Steamship Saxonia in the company of two of his assistants, Dr. Leavitt and Mr. Eaton, heading for Europe to study and to photograph type material of Philippine orchids preserved in the herbaria of the British Museum of Natural History, the Royal Botanical Gardens, Kew and Rijksherbarium of Leiden.

Perfection and persistence are the best descriptive expressions of the work of Ames and the studies carried out under his supervision. Both highly critical and scholarly books and papers were published one after the other in rapid succession and in a tradition that was not only expected but eagerly awaited by the scientific world. Thus, in 1905, the first volume of a series of seven was printed under the title, ORCHIDACEAE. His botanical resources, rich as they were, never satisfied him. Consequently, Ames's emphasis on documentation reached into the most unexpected places. Already in 1908, he had secured a full set of photographic reproductions of all orchid specimens from the herbarium of Linnaeus, kept in the Linnean Society in London, England, of which he was one of the few foreign fellows.

Step by step, year after year, he systematically built up a collection of photographic representation of types from Kew, the Lindley Herbarium and from Paris. The morning of May 6, 1914, when the provisions of the will of Reichenbach expired, the determined Oakes Ames was sitting on the steps of the Natural History Museum of Vienna awaiting its opening to have a first-hand look at the buried treasures of the Reichenbach Herbarium.

Over the years, a number of people helped Ames to build his ever expanding Botanical Laboratory. In 1915, the freshly graduated but polio-stricken Harvard man, Charles Schweinfurth, was hired to work in the Herbarium to look after the living orchids in the Ames's greenhouses. This new appointment turned out to be one of the rare concurrences of fate when the right man was given the right job at the right time. It did not take long for Ames to recognize that Schweinfurth's memory and especially his power of observation for minute details could be put to more constructive use in the laboratory than in the greenhouses. That prudent step paid a magnificent return. For the next 50 years, Charles Schweinfurth not only helped to expand the orchid herbarium, but also maintained its tradition of high scholarship and careful research beyond Professor Ames's active time of participation. His Harvard colleagues on November 29, 1965, presented him with a citation:

"Fifty years have passed since our colleague, Charles Schweinfurth, initiated his productive career in Orchidology. Dean of the world's orchidologists, like his predecessors Lindley, Rolfe, Reichenbach, Schlechter, Kraenzlin, Smith and Ames, he has made invaluable contributions to our knowledge of the systematics of the orchids of both the Old and the New World. His great number of publications, his elucidation of the intricate structures of orchid flowers, his augmentation to our knowledge of the phytogeography of orchids, his acute powers of observation for minute details, his loyalty and his dedication to his chosen field stand as an inspiration to both present and future students of orchidology. In grateful recognition of these fifty years of service to orchidology, we of the Botanical Museum of Harvard University, present this scroll."

Although fully committed to the study of the orchids of the Philippines, Ames was very much aware of the fact that the understanding of the complexity of the orchid family cannot be based upon a single, regional study. Therefore, studies on Central American orchids had already commenced in 1908, on Bornean orchids in 1918, a complete nomenclatorial revision of the orchids of the United States and Canada was completed by 1924, and the orchid flora of Peru was started in 1922. To these were added in the 1930's the orchids of Guatemala and the orchids of Mexico as well as the monumental revision of the genus *Epidendrum* in Central America.

Such a broad scope of undertakings naturally requires the joint efforts of many people. Professor Ames was fortunate to have had a very profitable and most cordial relationship with the elite of orchidology: Rolfe, Schlechter, Kraenzlin, J. J. Smith, Ridley, Hayata and Summerhayes. Even a scanty excerpt from the correspondence with these giants would easily amount to a sumptuous volume. Yet the cumulative knowledge of all and the ideas exchanged with each one of them together formed the time-tested foundation upon which the Orchid Herbarium as an institution proudly and firmly rests.

When Schlechter was preparing his book ORCHIDOLOGIAE SINO JAPONICAE PRODROMUS in 1918, at the end of World War I, he immediately got in touch with Ames, who not only helped him with much needed literature but also commenced to describe with him jointly several new species from China based on material in the Ames Orchid Herbarium. This cooperation blossomed into an important but little known partnership with the ultimate goal of publishing jointly a new FOLIA ORCHIDACEA, which eventually would cover all of the genera of the orchid family. Several unpublished keys to species of various genera attest to this undertaking in the archives of the Herbarium. Naturally, Schlechter's untimely death terminated the project. One important paper, prepared for this joint undertaking, DAS SYSTEM DER ORCHIDEEN was, however, published posthumously under Schlechter's name only, as evidenced by the unabridged copy of the original manuscript in the Ames Orchid Library.

Professor Ames always devoted full attention to the smallest details in every study he undertook. In the Schlechter-Ames project, he would have handled alone all of the genera endemic to the New World as well as those from the Philippines. To this end, an artist was employed by him in Berlin to make life-size drawings and tracings of all type specimens described by Schlechter. Hundreds of these drawings are now the only available information which we have of the Schlechterian species, since Schlechter's herbarium of some 100,000 orchid specimens was destroyed during World War II.

Busy and versatile as he was, Professor Ames never neglected to pay attention to enhancing the scientific value and expanding the resources of his by then world-famous orchid collection. In the summer of 1924, Ames agreed to pay some 400 German gold marks to Kraenzlin as a subsidy to publish Kraenzlin's MONOGRAPH OF MASDEVALLIA. On November 8, 1924, Kraenzlin requested additional help in the same amount. In return for this favor rendered, the Ames Orchid Herbarium now possesses a rather large part of the Kraenzlin Herbarium, especially of the species described by him.

The means and methods of acquisitions were indeed varied, but so is the collection, which is exceedingly rich in type and isotype specimens. The Herbarium's rate of growth not only exceeded all expectations but also reached such proportions and value that serious steps had to be taken for its preservation for the benefit of the scientific world rather than the personal interest of an orchidologist-philanthropist. Professor Ames, true to his stature as a farsighted scientist and conscientious philanthropist, made the following presentation to Harvard University in 1939:

> "It is now my intention to give my herbarium and associated library to the Botanical Museum of Harvard University under conditions similar to those governing the gift of my economic botanical collections in 1918, it being understood that during my active life I shall have control of the herbarium and its policies under the conditions that now prevail.
>
> "In order that my herbarium shall be efficiently maintained and in no way a burden on the university in the future, it is my intention at this time,. . . to establish a fund . . . the income from which fund shall be used to pay the salary of a curator. This fund with any subsequent additions to be recorded as the Oakes Ames Fund for Orchidology.
>
> "If at some future time the University should deem it wise to erect a fireproof structure to house the now scattered herbaria, I should be willing to have my herbarium, on the understanding that it should be kept as a distinct unit, (and to this there is no administrative obstacle), transferred to that building and be designated as the Orchid Herbarium of Oakes Ames . . .".

Perhaps it should be noted here that the Orchid Herbarium was housed first in Professor Ames's residence at North Easton, Massachusetts. Then, it was moved to his home at 355 Commonwealth Avenue in Boston. Eventually, it was installed in the Botanical Museum of Harvard University, where it was at the time that the gift was made to Harvard. One more move took place in 1954 to 22 Divinity Avenue, where a new herbarium building had just been completed. Unfortunately, Professor Ames died in 1950, but the members of the Corporation of Harvard University, through Mr. Kane, sought the approval of Mrs. Oakes Ames, because they wanted to honor him with a new location for his herbarium. The following exchange of correspondence is part of the record:

> "North Easton, Mass. June 29th, 1953. Dear Mr. Kane: It is gratifying to my children, as it is to me, that the Harvard Corporation wishes to place the Orchid Herbarium of Oakes Ames in the new Botany Building in a place of honor.
>
> "Our understanding is that can be done in accordance with the stipulation of his deed of gift to Harvard and his herbarium and library be kept as a working unit.

"I have told my sons and daughters of your kind explanation and intention and I should like to state again how much your interest has meant to us in these circumstances. Very sincerely yours, (signed) Blanche Ames Ames (Mrs. Oakes Ames)."

Mr. Kane's reply:

"July 2, 1953. My dear Mrs. Ames: Thank you so much for your lovely letter of June 29. It is indeed a source of great satisfaction to me, and I know it will be to the other members of the Corporation, to know that the placing of the Orchid Herbarium of Professor Ames in the new Botany Building will meet with your approval and that of your family. It is my understanding that not only can this be done in accordance with the stipulation in the deed of the gift of Professor Ames but also that the present members of the Department strongly favor this from the professional point of view.

"As details of the arrangements are worked out, we will be very happy to keep you informed.

"With kind regards, I am most sincerely yours. (Signed) R. Keith Kane."

44 years have passed since the Orchid Herbarium of Oakes Ames became the property of Harvard University. In 1954, the first official curator, Dr. Richard Evans Schultes, was appointed and held the office until 1958, when the present curator succeeded him. Many of the projects started or inspired by Professor Ames were brought to a conclusion during these four decades. During this period also, new projects were undertaken and new floristic studies completed. Above all, the available facilities have been much enlarged.

At the time of the gift, the Orchid Herbarium and Library of Oakes Ames encompassed some 60,000 herbarium specimens, over 2,000 bottles of orchid flowers preserved in alcohol, nearly 15,000 glycerine slides of dissected flowers and a highly specialized orchid library of approximately 2,000 volumes.

With these orchidaceous materials came also a very special gift, the collection of original drawings of Blanche Ames, wife of Professor Ames. These drawings, each a work of art by itself, lavishly illustrated Professor Ames's scientific writings. The highest quality of scholarship and the highest quality of art were truly wedded.

The Orchid Herbarium today has nearly 130,000 specimens—this number includes approximately 25,000 specimens on permanent loan from the joint herbaria of the Arnold Arboretum and the Gray Herbarium—and a working library of some 5,000 titles, as well as a collection of over 25,000 glycerine slides of dissected flowers. Moreover, it possesses a unique filing system of some 150,000 cards, recording every described orchid name, whether at the specific or infraspecific level.

The collection itself contains over 10,000 type specimens or type collections of species described by Allen, Ames, Blume, Robert Brown, Correll, Garay, Kraenzlin, Lindley, Pabst, Quisumbing, Reichenbach, Ridley, Rolfe, Schlechter, Schultes, Schweinfurth, Seidenfaden, Sweet, J. J. Smith and L. O. Williams.

The greatness of an institution does not depend upon its past glory, but rather upon its current vitality. Since funds have always been a major obstacle to progress at Harvard, the Curator for the past 25 years had to manage the Herbarium literally single handed, without any technical and secretarial help. To maintain a greater visibility among both scientific and horticultural circles, as well as to enhance its international image, the prestige of affiliation with the Ames Orchid Herarium has been extended by invitation to renowned scientists and orchidophiles to become research Associates in Orchidology. Such appointments also carry the prestige of being Officers of Harvard University for the duration of the appointment. Already listed among "Adjunct Appointees" of the staff of the Botanical Museum, these outstanding scientists and orchidologists through their harmonious team work have constantly ensured a high quality research. Although each and every one pursues independent investigations, their mutual involvement in each other's research, not through persuasion, but rather through scientific curiosity and dedication, reflects a healthy and sound environment which is devoid of competition for continuous productivity.

This productivity is clearly reflected in the number of books and lengthy monographs (nearly 50 volumes) and other scientific papers numbering in the hundreds, all of which were wholly or to a great extent based on the resources of this herbarium and library. It can be said safely, if not boastingly, that with a very few exceptions, all orchid floristic studies, especially those of the New World, were prepared either at the Ames Orchid Herbarium, or were mostly based on the holdings of this institution.

The Ames Orchid Herbarium has, indeed, become a haven for those who seek critical information about the unique Orchid Family. Being at the cross roads of scientific and horticultural endeavors, the facilities of the Ames Orchid Herbarium are continually used by a large number of visitors, especially those from foreign countries. Among the holdings of the Herbarium, the Philippine and Mexican collections are the most extensive in the world. This truth is so aptly expressed by Dr. Valmayor in the preface written in August 1983, to her two-volume "Orchidiana Philippiana", after having spent a considerable time in the herbarium for the preparation of these books:

> "The Ames Orchid Herbarium of Harvard University. . . is considered the mecca for Philippine Orchidologists, and this is because almost all the type specimens of Philippine orchids are represented in its collection. . . . Moreover, the Orchid Library of Harvard University is so extensive that almost all valuable early taxonomic books on orchids are to be found there."

May these kind words not only sum up the treasured history of this herbarium, but also keep on echoing it in every concerned heart for an unending and promising future.

Leslie A. Garay
Curator of the Herbarium

THE ECONOMIC HERBARIUM OF OAKES AMES AND THE TEACHING COLLECTION OF USEFUL PLANT PRODUCTS

One of the specialties of the Harvard Botanical Museum has long been the study of economic botany which includes ethnobotanical research. Extensive teaching and research in this interdisciplinary field have been carried on by the Museum staff for over a century. The course in economic botany, now entitled "Plants and Human Affairs", has been taught for 107 consecutive years by five educators; it represents the oldest course in the sciences at Harvard University and the oldest course on this subject possibly in the world.

Among the numerous facilities at the Museum which support teaching and research in economic botany, one of the most important is the Economic Herbarium of Oakes Ames. There are actuallly two separate Ames herbaria at Harvard: the Economic Herbarium located in the Botanical Museum, and the Ames Orchid Herbarium, now housed in the University Herbaria building.

The Economic Herbarium was presented to the University by Professor Oakes Ames early in 1940. Although a small herbarium of useful plants had existed previously from the collections of Professor Asa Gray and Professor George Goodale, it was Ames' efforts from the early 1900's to 1940 that assembled the beginnings of a significant and very specialized collection of herbarium specimens. The purposes of this herbarium were primarily for teaching and secondarily for scholarly research in economic botany and the ethnobotanical uses of plants. The species in this herbarium are designed to supplement, not duplicate, the extensive floristic collections of the Gray Herbarium and Arnold Arboretum; and with the Economic and Orchid Herbaria, Harvard's herbarium facilities total some 4,500,000 specimens.

The 125th anniversary of the Botanical Museum dates from 1858, when Asa Gray, Professor of Natural History at Harvard, received from Sir William Hooker, Director of the Royal Botanic Gardens at Kew, an acquisition of undetermined size of wood samples, pods, cones, nuts, witches' broom, palm trunks, monkey pots and other vegetable products of economic value for teaching purposes. During the following eighty years, the Botanical Museum grew to become an international centre where plant origins could be studied, drug plants identified and fibres compared. Under the ambitious guidance of Professors

George Goodale and Oakes Ames, the Museum's economic herbarium and products collection grew to nearly 10,000 pressed plants and 7000 vegetal products. Forty-three years ago, a description of the Economic Herbarium was published by Professor Richard Evans Schultes in *Chronica Botanica* v.6 (1940) pt. 4, p .90–91. The Herbarium's growth in scope and size during the ensuing years suggests the advisability of an updated account, and the 125th anniversary of the founding of the Botanical Museum provides an appropriate opportunity for such a review.

With the exception of ornamentals, the Economic Herbarium contains plants which are or have been useful or harmful to man, comprising both cultivated and wild algae, fungi, lichens, pteridophytes and spermatophytes. These general classes of economic plants are included: 1) plants of importance in agriculture (including the principal forage crops), industry and the arts; 2) plants used in primitive societies; 3) plants connected with superstition and religious rites; 4) plants of interest because of former uses or because of association with the old herbals; 5) wild species of significance because of their known or presumed association with the origin of cultivated plants and 6) voucher specimens of phytochemical analyses.

The Economic Herbarium which now numbers 41,000 sheets, has experienced a more than 200% increase in accessions since 1940. Arranged in accordance with the Engler and Prantl system, it comprises material of more than 500 families, 3300 genera and well over 11,000 species and varieties. Included in the Herbarium, as a supplement to the specimens, is a collection of 600 original drawings, watercolors and handcolored prints of economic plants. Another unique aspect of the Herbarium is the inclusion of over 300 photographs of the economically useful species from Harvard's Ware Collection of Glass Models of Plants. This superb public exhibit which is housed in the Botanical Museum and is used extensively for teaching botany by the various botanical institutions of the University, may be viewed as an adjunct herbarium in glass; it provides the scholar with 847 accurate three-dimensional species, including more than 2000 enlarged flower parts and cross sections.

The Herbarium contains material of value to monographers and general taxonomists, including a few types, numerous duplicate types, and drawings of types. There are extensive unique or rare collections which may be of critical or historical importance to students of taxonomy and floristics. *Iter Warburgianum,* the Faurie, the Kunstler, the *Species Blacoanae* and other rare collections are among those of special interest. A complete herbarium of Maiden's *Useful Plants of Australia,* only a few sets of which are known, is preserved in the Economic Herbarium. Ruiz and Pavón's collection of Cinchona barks, a gift from the British Museum (Natural History), and other special generic collections have very significant historical value to students of economic botany.

The Herbarium was initially very rich in Asiatic material. During the past forty years, however, research programs and field work in tropical America have added ample collections from this new world region. The extensive collections of Schultes in Southern Mexico and South America, especially in the Amazon; and the ethnobotanical specimens basic to the studies among the Kamsá and Kofán Indians of South America by Dr. Melvin Bristol and Dr. Homer Pinkley respectively, have enriched the Economic Herbarium. Dr. Tommie Lockwood's collection of Brugmansia primarily from the Andes, and Dr. Timothy Plowman's extensive collections of Erythroxylon and Brunfelsia as well as many other general ethnobotanical species from Colombia and Peru have been added as valuable resource material to the Herbarium. The Theobroma specimens basic to the thesis of Dr. Wertit Soegang are available, and the material on oil palms, especially of the Jessenia-Oenocarpus complex, by Dr. Michael Balick, are included as well. Representative material of Dr. Doel Soejarto's extensive collection of South America Saurauia have been deposited in the Economic Herbarium; and among additional noteworthy collections from other areas are Vestal's ethnobotanical specimens from the Navajo Indians; Schultes' useful plants of the Kiowa of Oklahoma; and Miss Marjorie Whiting's plants of the Kung Bushmen of Botswana, Africa.

Numerous ethnobotanically important plants of the northwest Amazon, especially of the Apocynaceae, collected by Dr. James Zarucchi, have been added to the Economic Herbarium; and an ethnobotanical collection of the useful plants of the Ecuadorian Jivaro Indians made by Mr. Melvin Shemluck, and extensive ethnobotanical plant collections made by Mr. E. Wade Davis in South America, especially in Amazonian Peru and Ecuador, help to enrich the facility. Professor Robert Bye's research on the ethno-ecology of the Tarahumare Indians of Mexico, and Mr. Richard Martin's studies of medicinally promising plants of the Peruvian Amazon, both represent unique additions. More recently, collections of Hevea, Micrandra, and wood samples for anatomical analyses were made by Miss Kristine Forsgard in Brazil along the Amazon inland to the Rio Negro area; and Miss Lynn Bohs' collection of Cyphomandra throughout the Andes, basic to her research in that economic genus of fruits, have also recently been added.

Several specialized collections of voucher herbarium collections have been set up in the Botanical Museum for reference use by scholars—extensive collections devoted to a single genus or species which are or will be valuable to future monographic or analytic studies. Among these are Professor Paul Manglesdorf's extensive maize herbarium, Dr. Walter Hodge's collection of Cinchona, mainly from Peru, and several thousand specimens of Hevea and its relatives made by Professor Schultes in the Amazon Valley. Also available is a Cannabis collection of several hundred specimens from many different areas of North America, Europe and Asia, many collected from the National Institute of Health-sponsored cannabis plantation in Mississippi. The collection is comprised of material introduced and planted from more than 300 localities around the world; their classification basic to a modern interpretation of the genus Cannabis.

There are five other herbaria at Harvard University, and every attempt is made to avoid duplication in the Economic Herbarium of material available in other institutions. The specimens at the Botanical Museum are, however, equally available to both monographers and specialists; and efforts are currently being made to send out material for annotation, citation in publications, and to fill in gaps in our representation of economic plants of the world. We believe that this specialized herbarium is and will remain basic to contemporary growth and interest in the teaching of and interest in economic botany.

The Economic Herbarium is catalogued under the Dalla Torre and Harms' genus number. It is closely integrated with an extensive collection of economic and ethnobotanical plant parts, including seeds, fruits, flowers, roots, woods, barks, oils, resins, rubbers and other vegetal products. This teaching collection of useful plant products numbers well over 14,000 entries and has had a 100% increase in accessions since 1940. Likewise available is a collection of 4000 habit photographs of economic plants, 300 related charts and graphics and a clipping file assembled over the past fifty years. All of these facilities are reinforced for teaching and research by the topically indexed interdisciplinary Economic Library of Oakes Ames with well over 35,000 titles.

A recent addition from the New York Botanical Garden is the collection of economic plants of Dr. Henry Rusby, dating from the early 1900's. Representing only a portion of Rusby's collected material, the 4000 specimens, stored in antique apothecary jars, is a unique part of a massive accumulation of medicinal and general economic flora from Arizona, New Mexico, Colombia, Brazil and the Lower Orinoco area. A preliminary examination of this outstanding collection by Miss Susan Rossi has already produced a long-lost type specimen of *Erythroxylon truxillense* and promises to yield other critical specimens.

The Curator of the Economic Herbarium from 1954 to the present is Professor Schultes. Since 1976, Mr. Scott Wilder has acted as Assistant to the Curator and Manager of Economic Botany Collections. He has revitalized the Museum's botanical holdings, has organized a separate and more effective collection of herbarium specimens for laboratory use in teaching, and rehabilitated exhibits in the Nash Lecture Hall where economic botany courses are taught. Graduate students, as part of their training within the department, have undertaken to assist the Curator and Mr. Wilder in day-to-day management of the Herbarium.

The value of the Economic Herbarium of Oakes Ames and the teaching collection of Useful Plant Products lies in their importance as tools of instruction and research in ethnobotany and economic botany as well as being a repository for voucher specimens of chemical analyses of plants by schools of pharmacy and chemistry and pharmaceutical establishments. The Botanical Museum has provided 125 years of accessibility to students of botanical science, and the Museum's specialized collections offer a facility for research which might be difficult or impossible to satisfy in the larger and more generalized herbaria dedicated to a study of the floras of the world.

Scott E. Wilder
Curatorial Assistant

THE WARE COLLECTION OF BLASCHKA GLASS MODELS OF PLANTS

Millions of persons who have visited the Boston area remember Harvard University as the home of the "Glass Flowers." Exhibited on the third floor of the Botanical Museum are 18 glass models of orchids which are now almost 100 years old. They arrived from Germany in April of 1887 as part of the initial shipment of glass models of plants created in the studio of Leopold and, later his son, Rudolph Blaschka in the small town of Hosterwitz-bei-Dresden, the first of 850 models produced by these artists between 1886 and 1936 and sent to Harvard in 23 shipments.

The first few shipments of models numbered in the twenties because of part-time production. Later, when the Blaschkas worked on plant models full time, 50 to 60 were sent at one time. After Leopold's death in 1895, Rudolph working alone sent fewer models in each shipment, usually in the twenties and none in some years due to World War I and other interruptions.

In the early 1880's, Professor George Lincoln Goodale, the first director of the Botanical Museum, was in the process of planning the Museum's exhibits. In addition to being very instrumental in raising funds for the construction of the building, he was preoccupied with plans for equipping the building for research and instruction. In order to provide materials for botanical instruction, he explored several possibilities. At that time, plant reproductions were being made from wax and paper maché, neither of which were really satisfactory for his purposes. He had in mind plant reproductions which would be on a par with the three dimensional specimens of animals he had seen in Harvard's Museum of Comparative Zoology where there were exhibited a number of life-like glass models from the Blaschka studio. Impressed with their fidelity to the living forms and believing that they might also make plants, he visited them in Germany. Cordially received, he stated the purpose of his visit. Leopold was reluctant to take on the project. Some years earlier he had made a few plant models, but in view of difficulties in receiving proper payment for them, he was resuming work on animals. Furthermore, the marine invertebrate models that he and his son were producing for many museums were providing them with a satisfactory income.

Professor Goodale must have been persuasive, because at that first meeting he did get Leopold to agree to create a few models to be sent to Cambridge. Reaching New York, they were badly damaged in customs. Notwithstanding this misfortune, the broken models were forwarded to Cambridge, where they were shown to a group of friends of the Museum. It was evident, even in their damaged state, that they were of very high quality. Two of the Museum friends present at this showing were sufficiently impressed to authorize Professor Goodale, on their behalf, to engage the artists to produce more glass models of plants. The Blaschkas agreed on a half-time basis, while continuing to produce models of marine invertebrates for other museums. They worked in this manner from 1887 until 1890, when they decided to work with plants or invertebrates but not with both. On April 16th, 1890, the die was cast in favor of plant models when they signed a ten year contract to make plant models exclusively for Harvard University.

The models were to be sent in two shipments each year. The contract stipulated that the payment for the models, 8,800 marks per year, would be payable in half-yearly installments, 4,400 marks on January first and 4,400 marks on July first. It was also agreed that all expenses of freight from the place of manufacture to Cambridge, of insurance and of consular certificates would be defrayed. On the 10th of the following month, May 1890, the two friends of the Museum who had agreed to finance the project—Mrs. Elizabeth Ware and her daughter, Miss Mary Lee Ware of Boston—presented the collection to the President and Fellows of Harvard College as a memorial to the late Dr. Charles Eliot Ware of the class of 1834. It was gratefully accepted and became a distinctive part of the Botanical Museum collections.

In the early stages of the assembly of this collection in Cambridge, it was shown to the public at various times. Later, when the collection assumed its final form and was exhibited in display cases made for the purpose, it became and still is very popular with the public. From 80,000 to more than 100,000 visitors view the models every year. Visitors from every state in the union and over fifty countries have signed our visitors' register. No record has been kept of the number of students who have visited the collection for study, but the number must be in the thousands.

When the production of the collection was started, judicious choices had be made concerning species to be represented, inasmuch as the duration of the project was then expected to extend over a relatively short time span. As it turned out, the original ten-year contract was renewed a number of times, so that eventually the collection included a good representation of the Plant Kingdom, from the simplest forms to the most complex and it is now arranged in accord with the Engler-Gilg phylogenetic system of classification.

The Blaschkas worked from material grown in their own garden from seeds and cuttings sent from this country and other sources. Some plants unsuited to growing outdoors in their area were made available to them from the greenhouses at the castle in nearby Pillnitz. In 1892, they needed certain plants not locally available, so Rudolph came to the United States and to the

Caribbean. He made drawings, color notes, and preserved some specimens to be taken back to the studio in Germany for use in preparing models. While he was in the United States on a similar mission in 1895, his father died, and he returned to his home immediately, never to return to Cambridge. Following his father's death, Rudolph continued making the plant models but in reduced numbers each year.

The question as to how the models were made by the Blaschkas and the existence or non-existence of "secrets" connected with their manufacture has been rather controversial. It can be said that, for all intents and purposes, there were no "secrets." Their methods for working with glass were known to other glass-workers at the time. No doubt certain techniques were handed down to them in the family which had for generations worked with glass. Furthermore, they had themselves probably developed approaches to their work that may have been unique. The singularity of their work was due to the combination of their various talents. They were both well grounded in the natural sciences. This familiarity was founded, not only on formal instruction in the classroom, but to a great extent on observation and study of the flora and fauna of their surroundings. Coupled with this was their possession of a highly developed artistic sense.

As to the actual creation of the models, we know that the heated glass was manipulated and shaped in various ways through the use of simple implements: pincers, tweezers and other small tools of their own devising. The various parts of a model were assembled with the use of the blow-flame and, in some cases, various parts, such as long slender stems, were strengthened by the inclusion of wire. Occasionally, some of the parts were formed of colored glass in which case the part was considered finished. In other instances, when the parts were formed of clear glass, they were assembled, and the surface was coated with a material incorporating mineral pigments. This technique was used for many of the plant models as well as for all of the invertebrates.

Preliminary analysis of the material that they used indicates that it was either a gum or glue or a combination of both.

Unfortunately, this material responds to variations in humidity. When the humidity falls, the material contracts and pulls away from the glass. For a number of years, the variation in humidity has caused the contraction and expansion of this material on some of the models to such an extent that it has separated completely from the glass, a condition readily visible in many plant cross-sections. A constant temperature and humidity system has been installed to reduce this damage to a minimum. By stabilizing the collection, it will prevent further depreciation.

There is another aspect of the creation of these models which should be mentioned. In the late 1890's, as Rudolph continued modelling plants, he became dissatisfied with the quality of the glass available to him, and he decided to make his own glass. Consequently, he had several glass furnaces installed in his studio and proceeded to produce glass himself from the raw materials. He further proceeded to work toward another objective: to improve on one of the techniques involved in his work. As mentioned above, many of the plant and all of the invertebrate models were made of clear glass and colored by applying a mineral material with glue and/or gum. This surface material could be scratched off and was susceptible to changes in humidity. It was Rudolph's intention to make the models in such a way as to eliminate these shortcomings. He prepared the parts of a plant of clear glass; instead of applying the glue-gum-pigment mixture, he added powdered glass of the desired color to the surface and re-heated the parts in the flame, thus fusing the clear and the powdered glass. It was a somewhat chancy procedure, inasmuch as the second heating of the part sometimes caused the glass to fracture. When successful, this process assured a more durable model. Rudolph was successful in this endeavor to a certain extent but we cannot say how many of the models were completed in this manner. We do know that some of the cross-sections were definitely made in this way, for it can be visually determined. Other models, however, may have been made in this way, but it cannot be detected merely by visual examination. After the application of powdered glass and fusion, the piece so treated appeared glassy; to overcome this deficiency, he coated the surface with a material to eliminate the glassy shine.

This information is available from a letter written by Miss Ware to Prof. Oakes Ames, the second director of the Botanical Museum. After having spent a day watching Rudolph at work, she wrote: "There is additional labor which I did not see. Annealing leaves the glass glittering and shining, and that appearance he destroys by the application of a certain varnish; and he applies this to the flowers also after stamens and pistils are set." There may well be any number of models made using this newer method, but to determine this would require very close examination. Based on the information now available, there is no record concerning the number of models that were produced in this way. The one exception mentioned earlier concerns the model of the Maple with the autumn coloring. We have letters about that model written by Rudolph in which he relates difficulties encountered to produce a glass of the proper red for the leaves: he wrote that the model had been fashioned almost completely in the new manner, except that the veins on the backs of the leaves had to be, as he put it, "helped with cold painting"—a reference to the application of the glue-gum-pigment material.

We hope that in the future it will be possible to analyze this material. If that were done, it would be possible to duplicate the surface material and thus restore areas of some of the models where the material has been completely detached and thus improve the appearance of these models.

Some models show more damage than the lifting or separation of the coating material from the glass surface. Almost without exception it is the leaf structure which has been damaged beyond repair. In these cases, the leaves are almost completely fragmented. It has been suggested that this destruction might be due to three factors: one is the strength of the coating material when it contracts; another is the thinness of the underlying glass; and the third is possibly the age of the glass. The only remedy would be complete replacement of the damaged part. Since glass workers able to do this very difficult work are probably unavailable, the only possibility would be to make a plastic replica of the missing part. This solution is completely feasible. Preliminary investigations along this line are now being undertaken.

The plastic replica could be put in place, and a label explaining the substitution could accompany the model.

Recently, possibilities have been explored to find a way in which the models might be cleaned, but to date no really satisfactory method has been found. The collection at present is housed in very well made horizontal and vertical exhibit cases, some of which date back to the 1890's. Although of high quality, they are aging. Many of them are still sound, but in some cases, the joints have dried out and have loosened. During the past ten years, a few have had to be repaired. Most of these repairs concern loose legs on the horizontal cases, discovered in moving the cases to install the recently completed air conditioning system.

The collection is adequately lighted, but it does have a few drawbacks. The light from the overhead fluorescent fixtures is reflected from the glass in the horizontal cases; the reflection interferes to a certain extent with viewing the models. Furthermore, the overhead lights cause shadows on parts of the models in the vertical cases. When installed, this lighting was probably the most satisfactory type available. If the entire collection were to be housed in vertical cases equipped with interior lighting, these drawbacks could be eliminated; then, all the models on exhibit could be seen by viewers at close range, an advantage not now possible for the models in the horizontal cases.

It has also been suggested that the collection could be "thinned out" somewhat and still maintain the phylogenetic continuity so useful for teaching purposes. With fewer models on exhibit, all in vertical cases, floor space would be gained to accommodate the increasing numbers of visitors. At present, the aisle space between cases is adequate when only a few people are present, but when groups of fifty or more are circulating in the aisles, the space is quite cramped.

Some years ago an attempt was made to raise funds to solve some of these problems, but it was only partially successful. A sufficient amount was raised to provide for installation of the constant temperature and humidity control system mentioned above. That environmental improvement was considered to be the most important need of the collection. Perhaps in the future, means will be found to solve the remaining problems so that this unique "marvel of science in art and marvel of art in science" may be in good condition a century from now.

William A. Davis
Keeper of Scientific Exhibits

THE PRINTING SHOP

The first equipment—the embryonic printing shop—consisted of a small foot-powered, 7 x 10 job press, and a few cases of type acquired between 1912 and 1914 for Mr. Louis C. Bierweiler, former curator of exhibits, to print labels for the Glass Flower display. Proliferation of his duties, however, made it impossible for him to continue to operate the printing press, and in November 1930, Mr. Howard J. Allgaier, freshly out of high school, assumed this reponsibility.

At that time, Professor Oakes Ames, Director of the Botanical Museum, an enthusiast for fine printing, decided to establish a real printing press operation as an eventual outlet for publishing the results of scientific research done by the members of the Museum. He often said: "A botanist's research should be a jewel worthy of a proper setting". To do that, in 1932, he acquired another foot-powered, 10 x 15 Golding job press. It was on June 7, 1932, that the Museum's own journal—the BOTANICAL MUSEUM LEAFLETS—now in its 29th volume, was initiated. This endeavor was highly successful and has materially contributed to the Museum's rapid rise to one of the most respected botanical institutions.

The following year, in 1933, Professor Ames, who at that time was also Supervisor of the Arnold Arboretum, used the new press to publish the Arnold Arboretum's BULLETIN OF POPULAR INFORMATION This publication contained half-tone pictures, the printing of which a "job press" was completely unsuitable. Yet, the problems were successfully overcome. The quality of printing at the Museum soon attracted the attention of various Harvard institutions: the Museum of Comparative Zoology, Department of Biology and the Medical School on a regular basis, while others used the facility occasionally.

The press was so successful that Professor Ames decided to try to print a full size book. In July 1936, the first, all hand-set, volume of 234 pages in Scotch Roman type, printed two pages at a time, was completed, and Ames, Hubbard and Schweinfuth, THE GENUS EPIDENDRUM was published. It should be mentioned that only 16 pages were set and printed at a time, then the type distributed so that another 16 pages could be set. The quality of this hand-set book on fine paper caused admiration in botanical circles which in turn gave the impetus for continuing the printing of books on an intermittent basis.

Realizing that a "job press" was not the right equipment to print the kind of books that he wanted to produce in the future, Professor Ames, in October 1937, purchased a 12 x 18 Chandler and Price power-press equipped with an automatic feeding system. This excellent press, although now outdated, is still in use 45 years later.

The printing of the second book Ames, ECONOMIC ANNUALS AND HUMAN CULTURE, 160 pages, 7½ x 12 inches, was completed in December 1939. From that time on, the press had very little time to rest. During 1939, Vestal and Schultes, THE ECONOMIC BOTANY OF THE KIOWA INDIANS, 110 pages, was also printed. In 1940, Taylor, PLANTS USED AS CURATIVES BY CERTAIN SOUTHEASTERN TRIBES; in 1941, Schultes, A CONTRIBUTION TO OUR KNOWLEDGE OF RIVEA CORYMBOSA, 45 pages; in 1947, Ames, DRAWINGS OF FLORIDA ORCHIDS, 190 pages, 63 plates, and in 1948, Ames, ORCHIDS IN RETROSPECT, 172, pages were all published.

During the intervening time, between 1941 and 1970, the press also printed JOHNSONIA, the occasional journal of the Mollusk Department of the Museum of Comparative Zoology, and for the same department, from 1945 onward, the OCCASIONAL PAPERS ON MOLLUSKS were produced.

In June 1976, after 46½ years of service to the botanical world in general and to the Harvard community in particular, Howard

Allgaier retired from full time service. Yet, on a part time basis, he continues to serve the needs of various Harvard institutions which desire the fine quality of workmanship that only hand-set printing can give.

Howard J. Allgaier
Printer to the Museum

PLATE 1

Photograph: E. Molitsky

Professor Richard Evans Schultes

PLATE 2

Photograph: Bachrach

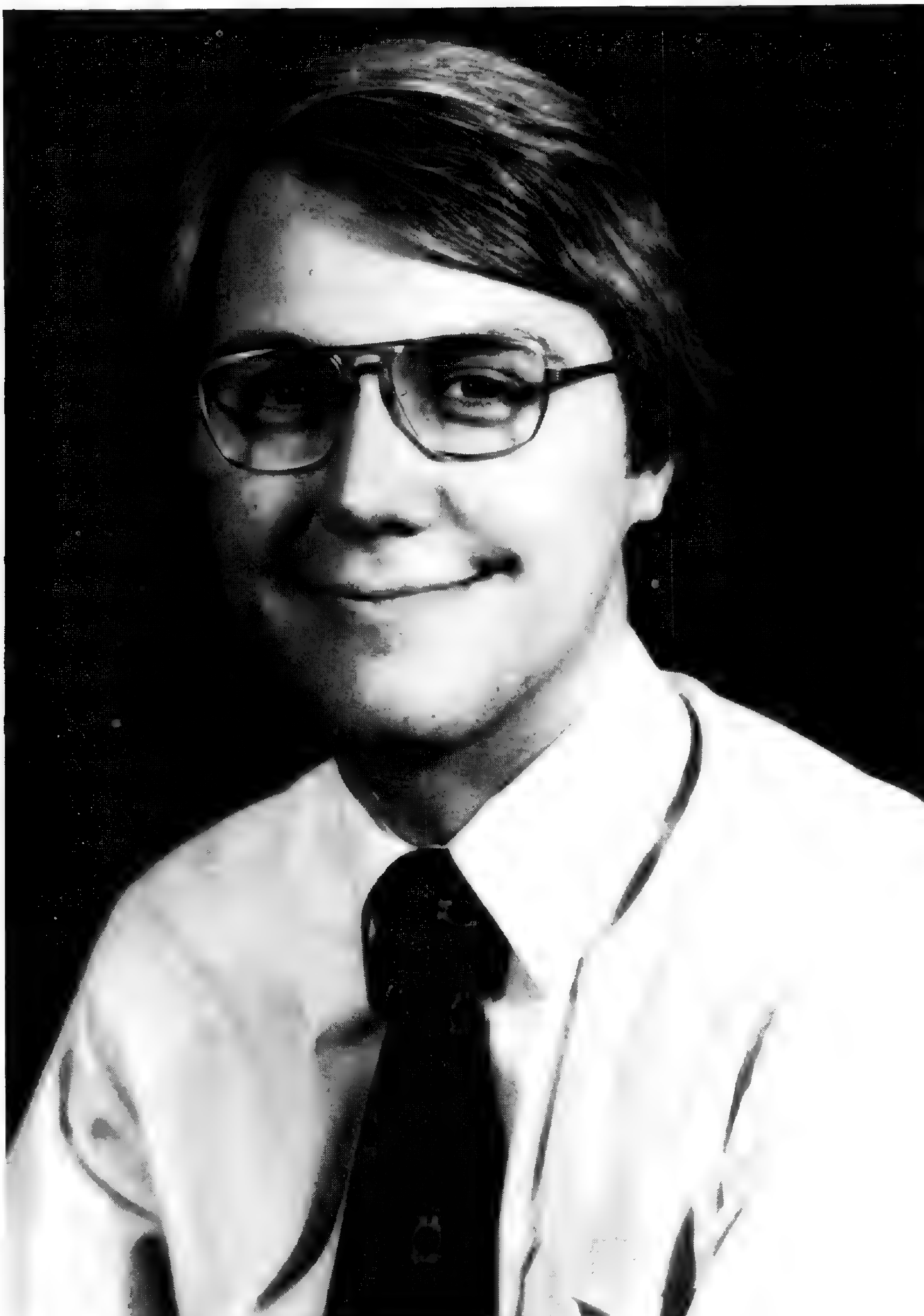
Professor Paul C. Mangelsdorf

PLATE 3

Photograph: Harvard News Office

Professor Elso S. Barghoorn

PLATE 4



Photograph: Harvard New Office

Professor Andrew H. Knoll

PLATE 5

Photograph: Hillel Burger

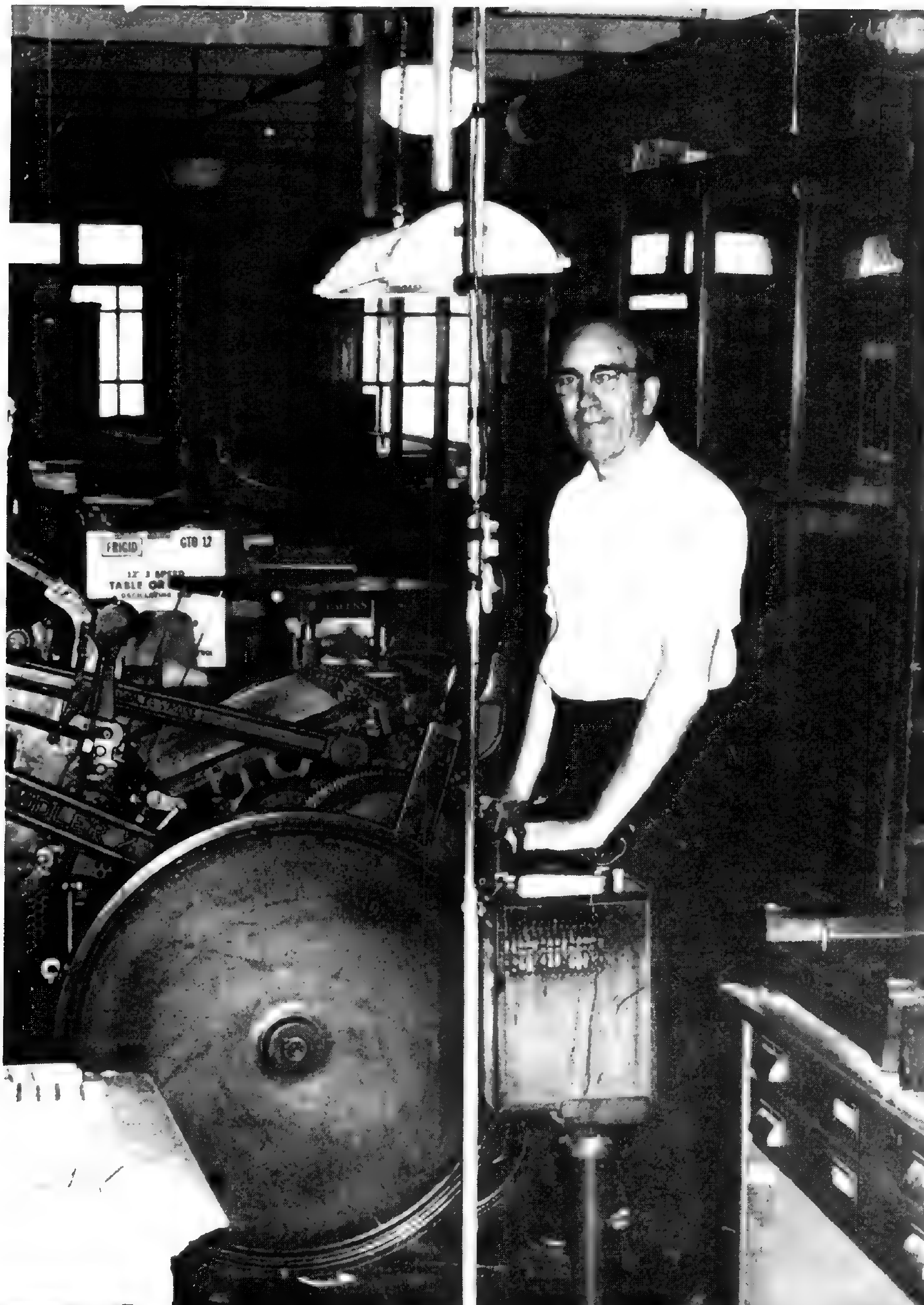
Professor Herman R. Sweet

PLATE 6

Photograph: Hillel Burger

Dr. Leslie A. Garay

PLATE 7



Mr. Howard Allgaier
in the printing shop of the Botanical Museum.

PLATE 8

Photograph: Hillel Burger

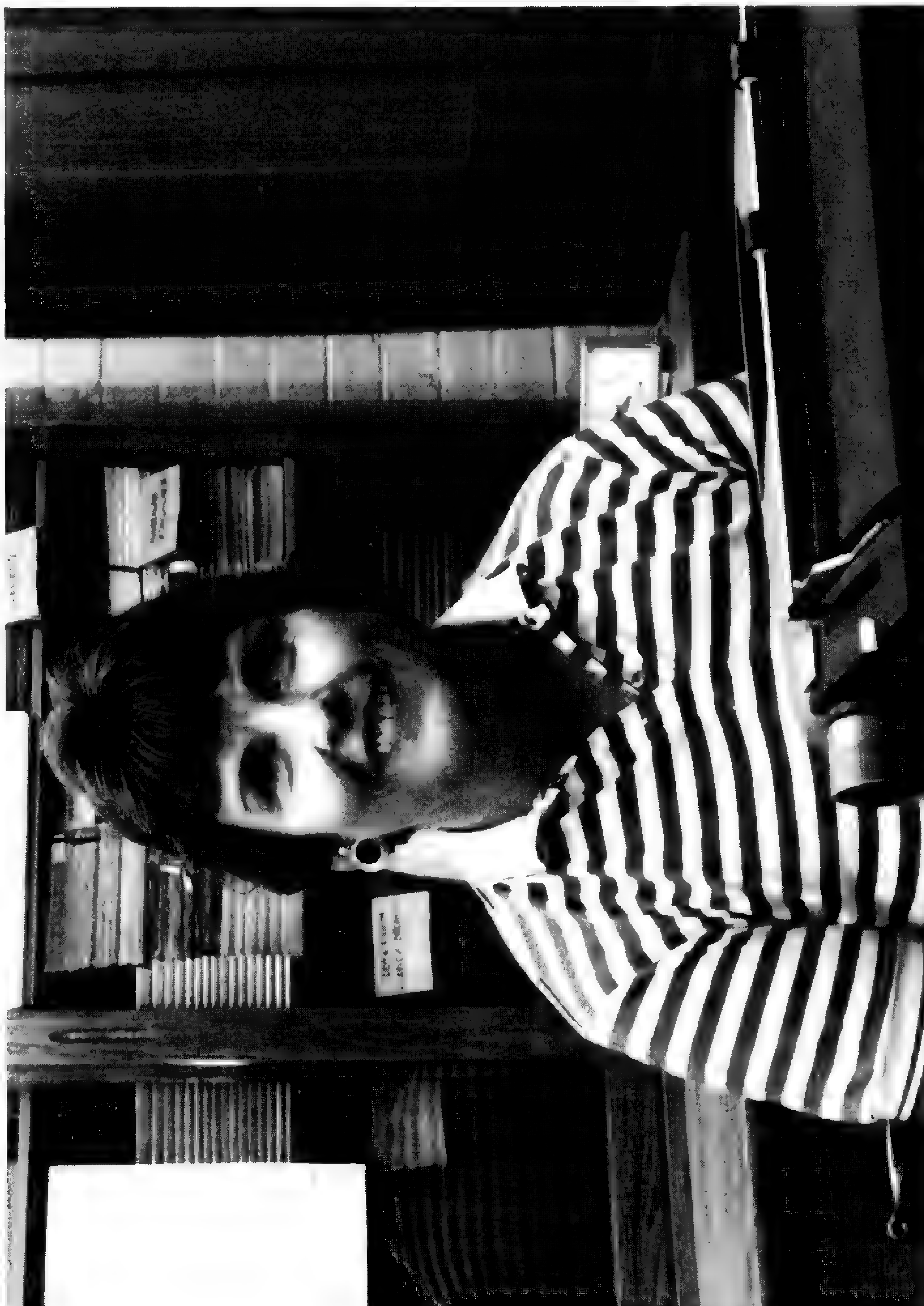
Mr. William A. Davis and Professor Richard Evans Schultes
explaining the Ware Collection of Glass Models of Plants
to Her Royal Highness, Queen Sirikit of Thailand, during
her recent visit to the exhibit.

PLATE 9

Photograph: Hillel Burger

Mrs. Mary R. Gaudet

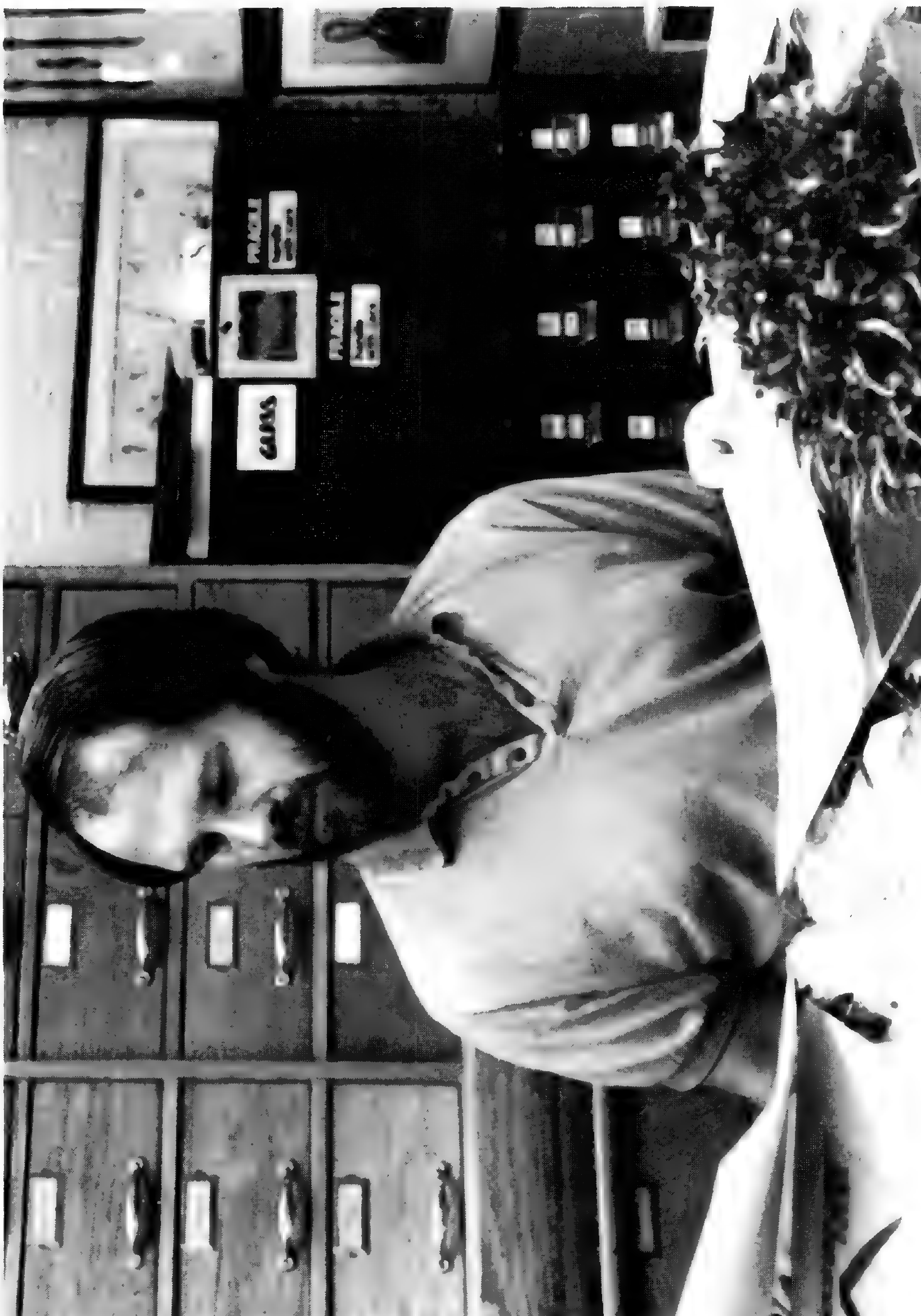
PLATE 10



Photograph: Hillel Burger

Mrs. M. Katheryn Harrow

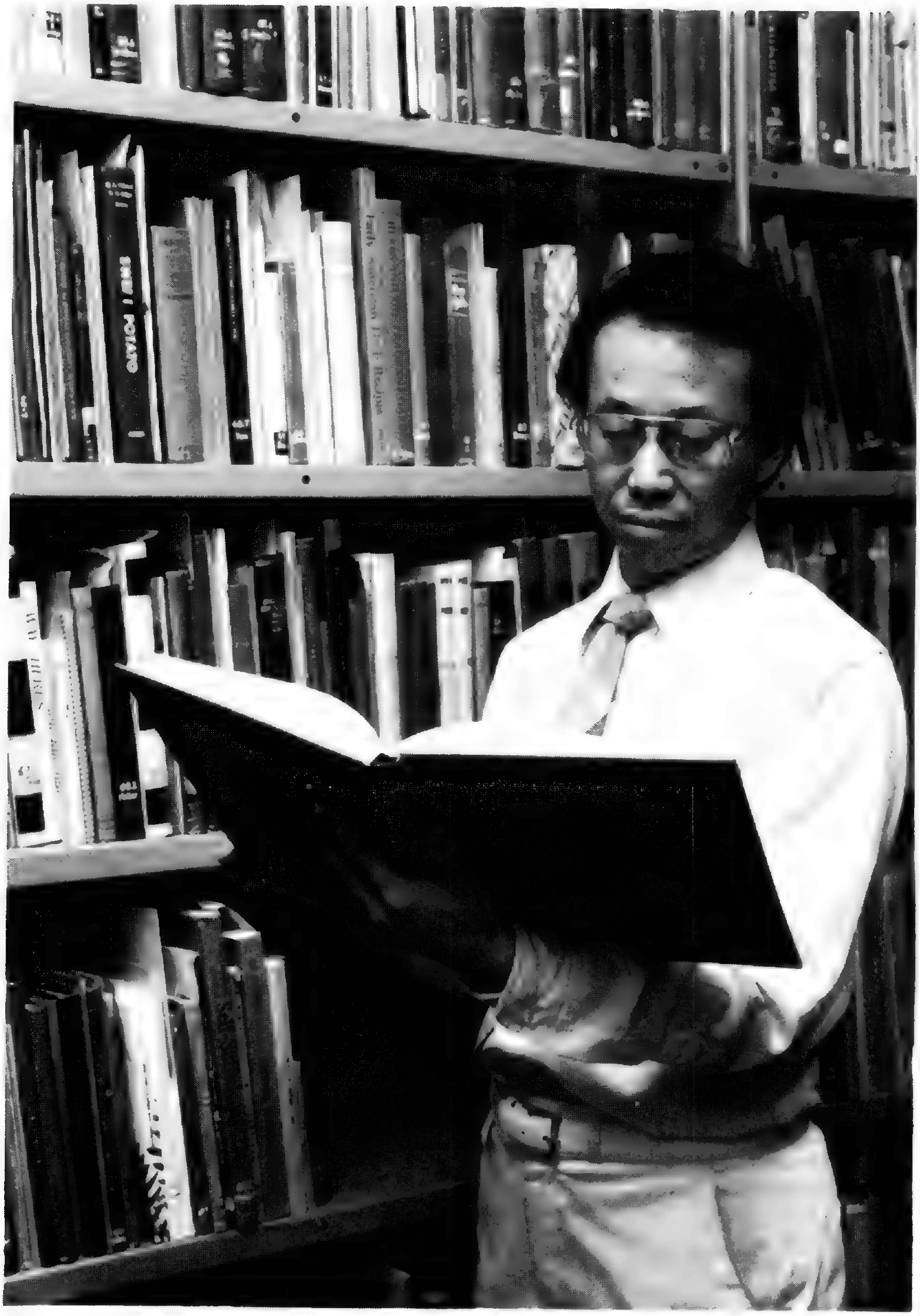
PLATE 11



Photograph: Hillel Burger

Mr. Scott E. Wilder

PLATE 12



Photograph: Hillel Burger

Mr. Wesley Y. Y. Wong

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STUDIES IN BARK CLOTH: *I. POLYNESIA*

DOROTHY KAMEN-KAYE, F.L.S.*

ABSTRACT

Bark cloth ("tapa" in the lingua franca of Oceania) is among the most ingenious conversions of plant materials to his uses ever devised by man.

From the inner bark (bast, liber) of three moraceous trees, and (less often) from a few other plants, he has provided himself, from very early times, with a cloth not only suitable for daily clothing but also with garments to be worn for ceremonial and religious observances or as an indicator of economic status. In parts of the world where climate and flora favor its manufacture and use, and from his loincloth to the "clothing" of his gods, man's use of bark cloth has been a basic element of his life for unnumbered generations.

Contact with cultures more technically advanced than his own has made available to him materials with which to replace his laboriously produced bark cloth, and has enabled primitive man in both the Old and New Worlds to abandon the use of bark cloth for clothing and domestic needs for suitable and practical substitutes. That he has not abandoned its use completely is evident from its presence today among the peoples of both Oceania and the Americas where groups retain the practice of traditional observances and customs. They continue to make bark cloth occasionally for everyday clothing, especially for work, and for mandatory ceremonial regalia.

The representative teaching collections of bark cloth in the Botanical Museum of Harvard University, which include examples from the 18th, 19th, and 20th centuries, constitute the basic references for this paper.

*Associate in Ethnobotany, Botanical Museum, Harvard University.

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FROM PAST TO PRESENT

The evolution of a museum in the twentieth century involves many challenges and some frustrations. Solving problems of provenance in the identifying of items in gift collections is especially baffling. Establishing provenance is a vital first step in determining the identity of an artifact in terms of its makers and where they live (or once lived) and of the materials and techniques of its manufacture. Although the journalist's "who-what-where-when-how—and sometimes why" is a useful beginning, the end of the story often hinges on "if" or "perhaps." And thereby sometimes hangs not a tale, but a mystery.

An intriguing mystery of the Botanical Museum collections might be called "the Minns Mystery." It concerns seven pieces of a collection of nine pieces of Polynesian bark cloth. What could be a key clue appears in Pauline Ames Plimpton's biography of her father, Oakes Ames, who was Curator of the Botanical Museum 1923–1927, and Director 1937–1945. Her book is a collection of excerpts from her father's journals, diaries, and letters.

Professor Ames mentions a visit from Miss Minns soon after the creation by an anonymous donor of a memorial fund to commemorate Professor Goodale. This could have taken place in 1923, when Miss Minns was in her eighties.

"Expressing her great admiration for Professor Goodale, she stated her wish to make a gift to Harvard for the benefit of the Botanical Museum, a memorial fund of $50,000. . . to be called the Mary Hancock Fund. . . the income to be used for economic botany." Professor Ames adds that "there was a twinkle in her old eyes" as she explained that the nest egg for the fund was a twenty dollar gold piece, a birthday gift to her great-grandmother, Mary Hancock, from her father.

Miss Susan Minns died in 1938, in her ninety-ninth year. The Botanical Museum is not mentioned as the beneficiary of any additional bequest in her will (dated July 17, 1936).

Instead, Miss Minns had lost no time in establishing the Mary Hancock Fund "of $50,000 in memory of Miss [sic] Mary Hancock. . . . The income only to be used for the Economic purposes of the Botanical Museum and may include the purchase of books."This note is dated 1924 in *Endowment Funds of Harvard University*—June 30, 1947, Clafin, Treasurer, 1948. There is no mention of tapas (bark cloth pieces) in the will, nor is there any record of a gift other than a printed card (unsigned, undated) stating that these seven pieces now in the collection are her gift.

When—and even if—she gave them, and how and from whom she could have acquired them, are still unanswered questions, but an obituary notice in the *Boston Evening Transcript* of August 2, 1938, provides an educated guess. Identifying her as a collector-botanist and a biologist at Woods Hole, it also refers to her attendance at the Cambridge School for Girls directed by Professor Louis Agassiz and his second wife, Elizabeth Cabot Cary. Professor Agassiz's son by his first wife, Alexander, then in his twenties, taught at the school. He later conducted several scientific expeditions to the South Pacific, where he collected native artifacts. Susan Minns, who continued her scientific associations into her mature years, is said to have performed botanical chores for both Louis Agassiz and Asa Gray. She may have received the pieces of bark cloth as gifts as a result of these associations or, like many residents of maritime Massachusetts at that period, may have received them from relatives or friends who had voyaged to "the South Seas."

At some time after 1976, Scott Wilder, Curatorial Assistant, in the Botanical Museum, reviewed the contents of storage rooms. He found two unlabeled packages wrapped in heavy paper. One of these was a roll of seven pieces of decorated bark cloth, with a printed card stating that they are the Minns gift and another card describing bark cloth in general. The other package contained a large piece of bark cloth, folded square, without any obvious identification. At the same time, Wilder found another large piece of undecorated bark cloth. A note folded inside it, dated August 17, 1928, signed "J. S. Pray", stated that it had been brought to him from Colombia "twenty years or more ago, and was said to have been made from the inner bark of one of the native trees."

The "Minns tapas" have been placed on display in the Nash Lecture Hall of the Museum. The single tapa hangs in the corridor opposite the Director's office. The third "find", now identified as a blanket, is not displayed. Other specimens of bark cloth from both Oceania and the Americas are displayed in the Nash Lecture Hall in a flat case with a bark cloth beater from the Pacific. In the rare book section of the Economic Botany Library of Oakes Ames of the Botanical Museum, there is a sample book of many pages of pieces of Oceanic bark cloth bound together.

In addition to these major items, other specimens of plant products related to the manufacture and uses of bark cloth are kept in storage.

BARK CLOTH DESCRIBED

As a distinguishing component of diverse cultures, bark cloth cannot be described alone in general terms. Not only are there both similarities and differences between the bark cloth of the tropical Americas and that of Oceania, northeast Asia and Africa, but also there are variants of manufacture and uses within these regions. The question, "Why?" constantly arises. The answer depends on availability of materials; on inter-group contacts; on hypothetical or known migrations; perhaps most of all on the myths and legends of a people and the sum of their customs over many generations.

In Oceania the population of certain islands rather than others, depended on ocean currents and winds and on distances within the limits of navigation by rafts with daggerboards and matting sails, by canoes with outriggers and sails, or by double sailing canoes (catamarans). On the other hand, in the tropical Americas, rivers and their watersheds and the locations and accessibility of mountain valleys were of paramount significance in the establishment of settlements.

Like other widespread culture traits that developed in the distant past (such as tattoo and body paint, shamanism and the use of consciousness-altering drugs), bark cloth is similar to a theme and variations in a musical composition. The theme is constant, and the variations develop the possibilities of the theme by means of additions and alterations, or even of new concepts.

This paper, in addition to stating the theme, considers such variations as are reflected by the designs, colors, and techniques of manufacture of bark cloth on the basis of study of the collection at the Botanical Museum. It divides this consideration into two parts: first, the bark cloth of Oceania and second, that of the Neotropics.

Bark cloth is defined as a fabric, as the generic term for all fibrous constructions. The term "textile" refers specifically to woven (i.e. interlaced warp-weft) fabrics (Emery 1966).

Emery summarizes the technique of bark cloth manufacture: "Beaten bark cloth is fashioned from sections of the inner bark of certain suitable trees and shrubs. . . The inner bark of trees and shrubs of the . . . Moraceae is especially suited to the production of beaten bark cloth, due in part at least to the natural interlacing in the fibrous structure. The wild fig, the paper mulberry, and the breadfruit tree yield the inner barks which are probably most extensively used for beaten bark cloth. . . .

"The length, breadth, and thickness of the finished fabric are not entirely dependent on the size of available strips of bark, since in addition to the extending effect of the beating or pounding, it is possible to bond separate pieces at their edges to increase the area, and layer to layer to increase the thickness.

"The combined soaking and beating, which results in crushing the succulent portions of the inner bark and felting the fiber structure, causes overlapping of superimposed pieces to adhere to each other and makes the reinforcement of weak or thin spots as simple and practical as are the additions to size and thickness. In lieu of natural bonding, glue, paste, gum, or sewing may be used to attach the strips, layers, or patches.

"The making and use of beaten bark cloth has a wide distribution through the tropical and sub-tropical regions of Africa, Southeast Asia, the islands of the Pacific (Oceania) and the Americas. . . .

". . . there is considerable diversity in the terms used in different areas to designate the finished fabric. . . . The most familiar. . . is tapa."

Bark cloth is known in the South Pacific by other names, depending on where it is made. It is hiapo or siapo in Samoa, Uvea, Niue, the Marquesas, and some other islands. In Tonga, the principal tree from which it is made is called hiapo and the bark cloth is gatu. In Fiji, both tree and cloth are masi.

Among descriptions of bark cloth, technical accounts such as Emery's must take first place in terms of clarity, accuracy, and dependability. Still, it is a temptation to supplement them with early eyewitness accounts. Classic among such accounts is that of Joseph Banks, naturalist on Captain James Cook's first voyage (1768–1771).

Brigham (1976) quotes from the journal that Banks kept (scientific names in brackets, added by Brigham). According to Banks, the Tahitians made bark cloth from "the internal bark or liber of three...trees, the Chinese paper mulberry (*Morus papyrifera* [*Broussonetia papyrifera*] the breadfruit tree (*Sitodium utile*) [*Artocarpus incisa*] and a tree much resembling the wild fig tree of the West Indies, (*Ficus prolixa*)....Their mode of manufacturing the bark is the same for all the sorts....The bark is stripped and taken to running water where, held down by stones, it is left for several days.

"The women servants go down to the river, and stripping themselves, sit down in the water and scrape the pieces of bark, holding them against a flat smooth board, with the shell called 'Tiger's tongue' (*Tellina gargadia*)...until all the green bark is rubbed and washed away and nothing remains but the very fine fibers of the inner bark....This bark is then spread out on plantain leaves, care being taken to form layers of equal thickness, and left overnight.

"It is then taken away by the women servants, who beat it in the following manner: they lay it upon a long piece of wood, one side of which is very even and flat...as many women as can work at the board together begin to beat it. [They use] a baton made of the hard wood, etoa (*Casuarina equisetifolia*)...about a foot long and square, with a handle; on each of the four faces...are many small furrows whose width differs on each face....They begin with the coarsest side...and continue until the cloth, which extends rapidly...shows by the too great thinness of the groves [sic]...that a finer side of the beater is requisite...they proceed to the finest side, with which they finish.

"Imperfections in the cloth are remedied by the principal women in the group, who trim edges and apply patches with the use of a paste made of the root of arrowroot (*Chaitea tacca*) [*Tacca pinnatifida*]."

Banks proceeds to the Tahitian method of dyeing: "They use principally two colors, red and yellow. . . . They also on some occasions dye the cloth brown or black, but so seldom that I had no opportunity. . . of seeing the method, or of learning the materials they make use of. . . . To begin with the red. . . . [It] is made by the admixture of the juices of two vegetables neither of which . . . have [sic] the least tendency to the color of red. . . . The plants are *Ficus tinctoria* and *Cordia Sebestena*. . . the fruits of the first, and the leaves of the second, are used in the following manner:

"The fruit. . . produces, by breaking off the stalk close to it, one drop of milky liquor. . . . This liquor the women collect. . . shaking the drop. . . into a small quantity of coconut water. . . . When the liquor is ready, the leaves are. . . well wetted in it, they are then laid upon a plantain leaf, and the women. . . turn and shake them about; afterwards. . . to squeeze them. . . and in about five minutes the color begins to appear on the veins of the. . . leaves, and in ten or a little more, all is. . . ready for straining. . . . For straining they have a larger quantity of the fibers of a kind of *Cyperus* grass (*C. stupeus*). . . . In this grass they envelop the leaves and. . . express the dye. [They keep the grass to use as a brush to lay the color on the cloth]. The receptacle for the liquid dye is always a plantain leaf. In laying the dye upon the cloth they. . . spread the outside of it with a thin coat of dye."

Banks mentions several other reds which are produced by mixing with the fig juice *Tournefortig sericea, Convolvulus brasiliensis,* [*Ipomoea pes-caprae*], *Solanum latifolium*. "Their yellow . . . is made of the bark of the root of a shrub (*Morinda umbellata*). This they scrape into water and after it has soaked . . . strain the water and dip the cloth into it."

In a footnote, Brigham expresses surprise that Banks does not mention the use of fern leaves as stamps, citing red leaves on yellow grounds as an example. In the description quoted, Banks does not describe designs. Kooijman (1972) notes the use of fern leaves as especially characteristic of Tahitian bark cloth decoration.

England was aware of the Pacific centuries before Banks sailed with Cook. In 1555, Richard Eden furnished the first collection of voyages in English, *The Decades of the Newe Worlde or West India*. Richard Hakluyt's *The Navigations, Voyages, and Discoveries of the English Nation* (Ed. 2, 1598–1600) became an indispensable source of knowledge about the still-mysterious parts of the globe.

Before these compilations appeared, Antonio Pigafetta's journal and his *Relation* of Magellan't circumnavigation (1519–1522) had astounded and edified first "His Sacred Majesty Don Carlos" (Charles V of Spain) in 1522 and then, in oral, written and printed form, became known all over Europe.

Pigafetta's mention of bark cloth in the Pacific may be the earliest detailed available by a European and, as such, must be regarded as significant. His *Relation* remains the only surviving record by an eyewitness of Magellan's voyage. Magellan's own journal and the records of those who succeeded him in command after his death in the Philippines have never come to light.

A young Italian who describes himself as "Patrician of Vicenza [therefore a Venetian citizen] and Knight of Rhodes", Pigafetta went to Spain in 1519 in the suite of the Papal Ambassador to the Court of Spain. Hearing of the plans for Magellan's voyage and wanting "to see the great and wonderful things of the Ocean Sea", he obtained permission from both King Charles V and the Ambassador to accompany Magellan as a volunteer. He sailed in the flagship, *Trinidad*, September 20, 1519, and returned to Spain in *Victoria* (the only ship to return) September 26, 1522. Upon his return, he presented to the King "a book written by my hand treating of all the things that had occurred day by day on our voyage." In March 1523 he amplified this account to his full *Relation*.

The source from which all four extant manuscripts—three in French, one in Italian—derive, is the copy of this *Relation* that he presented to the Grand Master of the Order of St. John in 1525.

Pigafetta, then in his thirties, was well equipped for his voyage. He had read travel books, including Marco Polo's account of his travels (but whether in manuscript or a printed book is not clear);

he had seen service at sea as a member of a military order; he was—as revealed in his writing—a man of unflagging curiosity, capable of absorbing observations and scrupulous in recording experiences. He not only kept a journal but also carried a notebook whenever he went ashore. Communication with natives was one of his gifts, as is shown by his inclusion of four native vocabularies in his *Relation*.

On a Sunday, Pigafetta writes, he went ashore "to see how the cloves grow." His descriptions here of both cloves and nutmegs could well be include in any botanical text.

The juxtaposition of these descriptions with that of the making of bark cloth suggests that possibly he saw it made on this same excursion. "The women," he states, "go naked like the others, with these cloths of bark, and those cloths are made after this fashion. They take a piece of bark, which they soak in water until it is soft, then they beat it with wood so that it becomes as long and as wide as they wish. And it is like a cloth of raw silk, with threads in it making it appear as if woven."

This and the following references to bark cloth are from the Beinecke-Yale manuscript, in French, translated and edited by R. A. Skelton.

Pigafetta's comments on bark cloth present puzzling contrasts of the accurate and the mistaken. For example, he describes "a bark as thin and supple s paper, which grows between the wood and the bark of the palm tree." To this exact description of bast fiber he adds that the palm is its source. Since palms have neither bast nor bark (as these structures are defined botanically), why does Pigafetta state in other passages as well as here that the palm provides the material for the manufacture of bark cloth whereas in some passages, he does not mention the palm?

Girl musicians wear "a garment made of the said palm cloth." A queen's attendants are naked . . . except that their shameful parts were covered by a cloth made from the palm tree. . . . The people of a certain island wear . . . only a piece of cloth made of palm around their shameful parts."

On the other hand, in two other descriptions of clothing, he refers to "cloth made of the bark of trees" and "the women are clad in tree cloth from the waist down." Mentioning the scribes of a ruler, he says that they write on "very thin tree bark", and he describes the sail of a junk as made of "the bark of trees."

There is no hint of a reason for Pigafetta's use of or omission of "palm"; possibly he saw bark removed from another kind of tree and, as a result, chose the general rather than the specific.

In his mentions of bark cloth, Pigafetta himself is not always primarily responsible for errors. In the Beinecke-Yale manuscript, it is stated that the bark is beaten "avecq du boys," translated as "with wood." In the Ambrosian manuscript, the phrase is "co legni", translated as "with bits of wood." Since there is no explanatory note in either translation, the answer to this puzzle must be that neither Skelton nor Robertson realized that Pigafetta could have been saying that a wooden beater was used. Pigafetta's description of the finished cloth as "like a cloth of raw silk with threads in it making it appear as if woven" stengthens this assumption. If undecorated bark cloth is examined with back-lighting, the "watermarking" made by geometrically patterned beaters is plainly visible and suggests the texture of woven cloth. Pigafetta was here most probably referring to an implement made of wood or even simply to a stick of wood used.

Mistakes are inevitable when observation is faulty or when translation stops at the literal although accuracy depends on extension. In addition, in the case of handwritten manuscripts such as Pigafetta's *Relation*, mistakes result from a scribe's misunderstanding of a word or when, in transcription, he alters a phrase.

What source is responsible for Pigafetta's statement that bark cloth is obtained from palms, is not stated in any of the literature consulted. In reading Marco Polo, he must have noticed (no matter which manuscript or printed book he used) that Polo nowhere mentions the palm, but refers either to "certain trees" or specifically to the mulberry, "the leaves of which are fed to silkworms" and in both cases states clearly that it is the inner bark that is utilized for making both paper and cloth for summer clothing in China.

BARK CLOTH IN POLYNESIA

The so-called "Polynesian triangle" extends from the Hawaiian Islands on the north to Easter Island on the east, to New Zealand on the south, to the Ellice Islands on the west (with a jog around the Fiji Islands).

The definition of the triangle is more or less arbitrary, because there are islands outside of its periphery that are considered "Polynesian" in material culture or in other respects (Goldman 1970). The islands of the South Pacific are of four types: continental islands, volcanic islands, coral islands (atolls), and raised coral islands (lacking reefs). Their variation in quality of soil and plant life influenced the pattern of South Pacific settlement by early voyagers. Some of these voyages are believed to have reached Polynesia between 1000 B.C. (or earlier) and 1000 A.D., according to evidence from tradition, archaeology and linguistics (Goldman 1970). By a slow rate of diffusion, peoples from areas west of Polynesia, probably from South-East Asia or East Africa, taking advantage of winds and currents, may have journeyed by way of Indonesia (Barrau 1963; Goldman 1970; Kooijman, 1972; Dodge 1976). By raft, canoe, double canoe—all equipped with matting sails and using primitive navigational devices—these voyagers emigrated from societies characterized by chieftanship, craft specialization, and rank and status orientation (Degener 1975; Goldman 1970).

They embarked their families and carried stores of food and water (some as water-coconuts) and they wrapped plants from their food-plots in damp earth or bark to preserve them for arrival at some landfall. Among these plants, in all probability, they valued especially the moraceous paper mulberry (*Broussonetia papyrifera*) and breadfruit (*Artocarpus altilis*), both indigenous to the lands from which they had come. These plants had furnished them with material for cloth and a basic food. Another moraceous tree, *Ficus* spp., they found growing wild on many islands in Polynesia, and they made bark cloth of it as well (Degener 1975).

Until the surge of European and American contacts following Cook's three voyages (1768, 1772, 1776) and into the early years of the nineteenth century, cloth made of beaten bark was the only fabric used in all but a few islands of Polynesia. On these few, the leaves of *Pandanus*, laboriously prepared, were plaited into a mat-like fabric as well as into mats of various types and uses.

Bark cloth was used for clothing and wall hangings, house partitions and bedding; it was also an integral part of ceremonial observances. In its manufacture, traditional techniques, carried out with traditional tools, went back for many hundreds of years. Implements, as well as the bark cloth itself and its decoration, were made from plants, with the single exception of a reddish clay used as a dye found on some islands and traded to others.

Culture change, initiated principally by Protestant missionaries, brought about the diminished importance of bark cloth (especially in eastern and marginal Polynesia) due in most cases to the abandonment of motives and occasions for its use. Today, bark cloth survives on some islands, principally in western Polynesia. It is still made for community use (e.g. weddings and burials) for which it is made and decorated according to tradition. Tradition also survives in formal academic events at the University of the South Pacific at Suva, Fiji, where academic regalia include a stole, the design of which features patterns of bark cloth together with decorations used on other native materials from islands where that univerity has branch campuses.

BARK CLOTH FROM POLYNESIA IN THE BOTANICAL MUSEUM

The teaching collections of the Botanical Museum include nine pieces of bark cloth, a book of bark cloth samples, and a beater. The problem faced by the Museum has been to establish provenance and to employ supplementary means of identifying this material. The Museum has been fortunate in enlisting the interest and assistance of Professor Simon Kooijman of the Rijksmuseum voor Volkenkunde, Leiden, in the establishment of provenances and in the availability of his publications on bark cloth. Originally approached with one specific query, Kooijman suggested that he be sent color transparencies for study and comparison with his own records at the museum in Leiden. These transparencies, sent to him as an addition to his personal resources, he presented to the Rijksmuseum. Thus, the name of Harvard's Botanical Museum has been added to those of other sources of information on bark cloth around the world.

Professor Kooijman's opinions on the Botanical Museum bark cloth are quoted verbatim. His illustrative references are taken from his *Tapa in Polynesia* (1972), based on data recorded in the literature and on inspection of museum collections around the world. For his botanical identifications he consulted botanists from the Rijksherbarium, Leiden. Notes supplementing Kooijman's comments are the result of exhaustive search in the literature, including supplementary data on Polynesian bark cloth from his field study, *Tapa on Moce Island, Fiji* (1977).

Nash Lecture Hall-Lab. 7 pieces: ("the Minns Tapas")
Accession number 8610 (same for all).

Case 407: 5′3″ × 3′7½″ (158 × 110 cm); black on ecru.

Case 408: 48″ × 34″ (113 × 85 cm); black and brown on ecru. (Both are circular patterns).

Case 407: "I do not think there could be much doubt as to their Samoan origin. Elements of the pattern of 407 supporting this idea are the row of triangular points at the outside (T.i.P. Fig. 222), the frequent use of hourglass-shaped motifs (T.i.P. Fig. 185), and the central figure which is probably related to the swastika figure (T.i.P. Fig. 220 shows such a figure consisting of four elements). Moreover, the inner part of the pattern seems to suggest a turning movement. . . not uncommon in the decoration of Samoan tapas (T.i.P. Figs. 211–216, 220)."

Case 408: "The pattern of 408 is static in character. The central motif equals the one in T.i.P. Fig. 220. This pattern also shows rows of triangular points. The second circuit from the middle is filled with a rectilinear decoration comparable to the one in T.i.P. Fig. 181. The row of motifs in the first circuit remain a puzzle."

Note: These motifs suggest the shape of the stingray, with zigzag tail representing motion. According to Grzimek's *Animal Life*

Encyclopedia, 1973, Vol. 4, some species of stingray inhabit Pacific waters. One of these, *Taeniuya Lymna* (sometimes over six feet long) frequents shallow waters at night, where it is a hazard to bathers and divers. Since animal forms are known to appear in some tapas as well as in tattoo designs, this stingray theory may well be valid. Professor Kooijman (pers. comm.) would agree if there were evidence of folk experience with rays reflected in folklore or sayings. Nelson 1925 and Schultz 1945 list a popular Samoan saying: "The stingray (fai) escapes but it leaves its barb behind," which expresses a common conviction that "the evil a man does lives after him." In his *Narrative*. . .(1853, Vol. I) the Rev. William Ellis, enumerating South Pacific sea fishes, mentions "a great number of the ray species, from the large 'diabolus' to the smallest kind. . . ."

Case 409: 5′9″ × 3′ (173 × 90 cm); black and brown on ecru. "The tapa of 409 is unmistakingly Fijian. The one in my photo collection nearest to it is the tapa from the Smithsonian Institute [Institution] collected during the Wilkes expedition (T.i.P. Fig. 348). The latter was probably acquired on Vanua Balavu. I should hesitate however, similarly to locate your tapa. There are quite a few tapas with this kind of patterning which are only generally localized 'Fiji' and we do not know whether this type may have had a wider distribution."

Note: Plate 12 in Brigham 1976 shows a Fijian example of this same design of "hairy diamonds" alternated with conventionalized birds in the outer border (collected at Suva, Fiji by Brigham in 1896). Birds also appear in Kooijman 1972, Figs. 337 and 409. The absence of birds in the Botanical Museum example may or may not alter provenance.

Case 410: 4′7½″ × 33″ (140 × 82 cm); black and brown on ecru. "As to 410, I tend to ascribe it to Uvea (Wallis Island). The Bishop Museum in Honolulu is in the possession of a collection of Uvea tapas, some of which were published as illustrations in T.i.P. Figs. 229 ff. In my files in the Museum I found the photo of Bishop Museum C 5101 (32737), the pattern of which in its general design looks like the one of 410."

Note: T.i.P. figures 229 and 232 feature oval motifs placed diagonally in squares and rectangles of rubbed design, apparently drawn freehand similar to those on the Botanical Museum piece. In view of the use of animal forms on tapas, there is a possibility that this represents bêche-de-mer (trepang, sea slug). This marine animal, great numbers of which inhabit the shallow waters off reefs in the Fiji area, became an especially important item of the Pacific trade with China between the 1820s and the 1840s (E.S. Dodge, 1965, 1976). Since a large working force was recruited to harvest and cure these holothurians, they could have engaged the attention of the islanders even to the point of representation in tapa patterns. Those shown could have been added to already completed rubbed designs done with design tablet techniques. The design of this example is probably of Uvean origin and would have been made on a leaf design tablet, not one of carved wood. Leaf tablets are made of layers of *Pandanus* leaves laid crosswise to each other, interlaced and sewn tightly together with coconut fibers. A relief design is superimposed on this foundation and appears on the bark cloth when it is stretched on the tablet and rubbed with a dye-saturated wad. This rubbed pattern is later strengthened and emphasized with hand painting in a darker color. In this case, the emphasis is on the darker oval shape which may or may not represent a sea slug.

The rubbed pattern of this tapa has a wide border of scattered hand-painted motifs and a narrower border of very dark brown or black, the edge of which is cut into large triangular dentils. In Kooijman (1972, Figs. 234 and 235), there are similar pieces attributed to nearby Futuna (Hoorn Islands). Brigham (1976, Plate 224) depicts a very similar piece.

Case 411: 4′6″ × 5′3½″ (135 × 159 cm); black and orange on ecru. "I am not sure about 411. I did not find similar patterns in my photo collection of western Polynesian tapas. However, I would suggest a Samoan origin, mainly because of the cross-like flower motifs which I found in a more stylized form on a Samoan tapa (T.i.P. Fig. 194)."

Note: The cross-like flower motifs of the Botanical Museum piece are angled on oblique parallel lines covering its entire surface. Many of the "flowers" are black or black-barred and some are bright orange outlined in black.

Orange is not listed among characteristic tapa colors in Kooijman (1972, Table E), but it may be assumed that orange might be produced by mixing red and yellow. On the other hand, *Bixa Orellana* was introduced in the early 1800s into the Pacific (Merrill 1954; Brigham 1976), so it could have been used in this case. *Bixa Orellana* contains two coloring components: orellin (yellow, soluble in water) and bixin (red, soluble in both water and greases) (*Kew Bull.* 1887, No. 7). Depending on its preparation, *B. Orellana* may produce cinnabar red, orange, or yellow.

A third possible source of orange might be turmeric (*Curcuma longa*) utilized in Polynesia for generations as a yellow dye. The tubers of *C. longa* produce yellow, yellow-to-orange, red or a reddish-brown colors (Burkill 1935; Hill 1952). The question of dyes—their identities and preparation—is complex in itself. If the reports of observers were consistent, at least a color in question could be determined. The color of leaf-forms on this tapa, for example, was seen by various observers as pink or even red rather than orange.

Case 412: 4′2½″ × 22½″ (128 × 58 cm); black, brown, brownish red on ecru. "[Its] Futunan provenance cannot possibly be doubted (T.i.P. Fig. 256 f)."

Note: This tapa has a sort of checkerboard pattern. Kooijman (T.i.P. 1972) calls attention to the step-shaped motif seen so frequently on these tapas "that it may be regarded as a 'guide fossil' to borrow a term from geology, to the Futunan origin of the tapas carrying it." He adds that this motif "shows a strong resemblance to patterns formed by weaving and plaiting techniques (Figs. 241, 242) for mats." Accepting this resemblance, he speculates with emphatically expressed caution, on the transmission of these patterns to islands where bark cloth was made. He summarizes the possibilities: ". . . it may be said that the *salatsi* represent an old, traditional form of tapa decoration borrowed from Marshall Islands plaiting patterns and owing its origin to overseas contacts. . . made either via intervening island groups or directly from the Marshall group. It is also possible that in the early period European or American ships played a role in this contact (T.i.P. p. 282)." [This question of borrowings from island to island arises constantly when provenance is considered.]

This piece, identified as Futunan, is enriched with a narrow border of figures picked out in dark red to match a wide border of the same rich coloring.

On some islands of Polynesia, both tapa and mats were made. According to Buck (1930), household furnishings and clothing were made from both the beaten and decorated bark of *Broussonetia papyrifera*, the paper mulberry, and the laboriously prepared leaves of at least three species of *Pandanus*, all of which were cultivated especially for these uses. When she first arrived in Samoa, Mead lived for ten days in the house of a Samoan chief's family where "a great tapa curtain some 12 by 20 feet, was stretched across one end of the oval house to make a room for me, and my bed and Fa'amotu's were behind it. For my bed some twenty fine mats. . . which it takes a woman a year or more to make. . . were spread upon the floor. . ." (Mead 1977). Mead (1973) describes the types of mats used in Samoa and how and at what age girls were taught to plait them and also how to make decorated bark cloth.

Case 413: 5′5″ × 46″ (163 × 125 cm); black and brown on ecru. "[the tapa] is definitely Samoan. You can compare it with the drawing in T.i.P. Fig. 182. The latter was taken from a tapa in the Peabody Museum in Salem. I sent the photo to Mrs. Maxine Tamahori in New Zealand, who is an expert on Tongan tapa. . . . She wrote to me that the pattern appeared to be a Tongan arrangement. I think, however, that she was mistaken, being so much concentrated on Tongan material but knowing too little about Samoan bark cloth and Samoan designs."

Note: A possible reason for confusion in establishing provenance may be that this piece seems to have been brushed over with a semi-transparent reddish-brown glaze before the pattern of triangles was painted on it. According to Tamahori (1963), this glaze, a Tongan technique, gives the cloth stiffness and imparts a slight gloss to its surface. On the other hand, the character of the pattern cannot be questioned. Kooijman (1972) sees "the square and the rectangle containing diagonal lines crossing from the corners [as] one of the basic motifs of the Samoan tapas." This piece may be considered an instance of a Samoan borrowing of a Tongan technique.

In addition to his identification of the group of all nine examples of Polynesian bark cloth in the Botanical Museum, Kooijman provided information on one of two other tapas that round out the collection:

Fifth floor corridor, mounted on wall.
Accession number 8615 (iden. ACR, 11 and 11D) 7′5″ × 6′3″ (223 × 183 cm); black on white.
"I found your ACR No. 11 (11-D) in my own file. I photographed the tapa in 1954 during my research in museums in New England. The piece was not localized, and I suggested then that it came from Niue. This localization seems to be corroborated by the similarity of the lowest figure in the second vertical row from the left to one of the figures in T.i.P. Fig. 275. On the other hand, however, the figures in the pattern of the Botanical Museum piece have also elements characteristic of Samoan bark cloth patterns and because of that, I have begun to doubt the Niuean origin."

Note: The white ground of this tapa could have been produced with a wash of white clay. The thickness and stiffness of the bark suggest use of *Artocarpus altilis* which, according to some reports, furnishes a whiter and stiffer cloth than does *Broussonetia papyrifera*.

From whom and at what date the Botanical Museum received this piece is not known. In anticipation of the present study, the four corner areas of its reverse side (where identification is customarily placed) were examined and no labels were found. Some time after Kooijman's list of provenances was received, this piece was taken down for temporary storage. An examination of the entire reverse side disclosed pasted at the center, a blue-bordered 2″ × 3″ gummed label which showed no sign of age and a green jeweller's tag attached by its string to the bark cloth. Both bear the number D 2001 and on the label there is also, in blue ink, the letter C. On the label, in brown ink (faded from black?) is written in a nineteenth century hand: "Hiapo (or Tapa) from Savage Island." Near the label is scrawled a large $3.50; there is also a word (indecipherable) scrawled over with blue-pencil.

The original name of Niue was "Savage Island", so named by Captain Cook in 1774 because of the hostility of the inhabitants. Kooijman's identification is thus confirmed by the evidence on the tapa itself, assuming that its provenance was correctly noted in the first place.

Accession Number 8611:
Flat case 409: 133″ × 20″ (338 × 51 cm); black on reddish brown. Sash (oro), part of a wedding costume, a handsome example of contemporary decorated bark cloth made on Moce Island in the Lau group of the Fiji archipelago. The only example of Fiji's contemporary tapa (masi) in its collection, the Botanical Museum received this piece in 1980 as the gift of Mr. and Mrs. Alan Bodger, who acquired it in 1979 while residents of Suva, Fiji. This oro, worn over a skirt (sulu), is elaborately finished with deep cut fringe and on one side has fringe consisting of triangular, pierced dentils dangling from thin strips of bark cloth. The predominant figure decorating this sash is a favorite, the conventional vutututki, alternated with smaller rosette figures of various designs, all set off with repeated motifs forming borders which extend onto the fringe at both ends of the oro.

These ornamental patterns are applied by means of stencils in a technique unique in Oceania to Fiji. Until recently, the stencils were cut out of banana leaves. The name drudru (leaf) is still applied to the stencils used today, but they are cut from 14″ × 17″ exposed x-ray film.

An unusual feature of this sash is the clear reddish brown color of the cloth. Staining large pieces of cloth brown before decoration is applied is characteristic of Tonga. The reddish brown color is developed by either smoking or immersion. The smoke of a slow fire made of either *Cordyline terminalis* or of green sugar cane (*Saccharum officinarum*), over which the cloth is suspended, is preferred (Roth 1934). Sometimes the cloth is soaked in coconut oil before being smoked (Thompson 1940). The immersion method consists of soaking the cloth in oil mixed with powdered mangrove root and drying it indoors to develop a burnt orange color.

The black coloring matter used in Fijian stenciling is a mixture of kesa, a liquid dye extracted from the roots of the gadoa tree (*Elaeocarpus Storckii*) and soot. In former times, this soot was produced by burning the kernels of candlenuts (*Aleurites moluccana*) in a smoldering fire over which was suspended a large shell or a sheet of tin rubbed on the under side with the bark of *Hibiscus tiliaceus* to make it sticky. The thick, oily smoke thus produced accumulated as soot.

This method has been superseded today, with few exceptions, by the use of a kerosene lamp turned so high that the wick smokes, placed in a biscuit tin with one side removed. The soot accumulates in thick layers on the side of the tin (Kooijman 1977).

Accession number 8614:
Economic Botany Library of Oakes Ames (rare book case; RB49)
Sample book, approximately 14″ × 9½″ (36 × 24 cm). Original binding (Russia leather, in poor condition, replaced 1981).

Examined when it had its original cover, this book was found to contain some fifty leaves of bark cloth samples, approximately 13½″ × 9″. Most of the pieces are patterned. Undecorated leaves, when viewed with back-lighting, show the "watermarking" made by the geometric patterns on beaters especially characteristic of Hawaiian bark cloth. On the first page is written, "From George G. Kennedy, M.D., Milton, Mass. This gift to the Harvard Botanical Museum was received May 29, 1906."

Originally pasted onto the inside front cover and now reattached there, is a clipping apparently from an unidentified sale catalog: "1198-Sandwich Islands [Hawaii]. Tapa cloth or natural lace made from the inner bark of one of the lace-bark trees, *Broussonetia papifera* [sic]. A volume containing 56 leaves of this cloth in different thicknesses and examples of the patterns dyed with the vegetable dyes such as are used by the natives. Size of leaf, 9 × 13½ inches, bound in half russia. Evidently a collection by some traveler or missionary. Exceedingly interesting, and unknown to many people."

Note: This sample book is very similar to one at the Boston Athenaeum (original binding, housed in a box, and to date unidentified). The two books have a general resemblance in most respects, including size and character of contents. Both contain examples of the same tapa designs and both contain approximately the same proportion of patterned and "watermarked" leaves. Some of the designs in both books are like those known to have been made by means of Hawaiian bamboo stamps (Brigham 1976, Plate 41) and the "watermarked" pages show patterns like those of Hawaiian beaters.

It is possible that the same compiler put both books (and possibly others) together, all cut from the same large pieces of tapa. Since neither contains any text material, it is likely that they were privately, rather than commercially, produced.

In 1787, bound volumes of bark cloth samples accompanied by a text were compiled and printed for Alexander Shaw. According to Kaeppler (1978) "a large number of the pieces included are from Hawaii and because of the date, it is unlikely that the pieces could have come from any other voyage than Cook's." Some pieces, she adds, are from the Society Islands and Tonga, and a few may be from Rurutu. Kaeppler states that about thirty Shaw volumes are known today (from many of which sections of leaves have been cut out). Also extant are other bound collections of bark cloth about which she does not offer details. According to Anne Leonard (1980), of the copies extant "each copy has a somewhat different selection and arrangement of tapa specimens."

Some so-called "pirated" pieces of decorated bark cloth have come to light in Cambridge during research for this paper. In 1982, a large piece with a rather unusual blue background that was brought to the Peabody Museum of Harvard University for identification had a piece measuring about 9″ × 12″ cut out of one border. There are several small, obviously "homemade" booklets of decorated bark cloth pieces in storage at the Peabody Museum. Two of these are stitched together with ordinary sewing-thread (38-48-70/907). Another is accompanied by a handwritten note identifying it as bark cloth from the Hawaiian Islands, 1872 (142-15-70/2019). A third contains six undecorated, "watermarked" leaves (37623).

That there was no particular public disapproval attached to the use by individuals of pieces cut from large tapas is proven by a touching incident: Mrs. Cook, expecting Captain Cook's return to England from his third voyage and anticipating his appearance at Court, ws embroidering paired pieces of decorated bark cloth for a waistcoat when the news of his death reached her. The pieces have been preserved—the embroidery never finished (Kaeppler, 1978, Fig. 221).

Accession number 8443:
Flat case 409
Bark cloth beater (ike and variant spellings). Overall length, 14″ (35¾ cm), four-sided; three grooved sides (8 or 9 grooves each), one smooth side; handle rounded, slightly flared at bottom; differing from a great number of beaters examined at museums and reviewed in the literature, it has a pyramidal top arising from its four beating surfaces, instead of the usual squared off, flat end.

In a case of artifacts from Fiji at Harvard's Peabody Museum, there is a four-sided beater collected 1897–1898 by Alexander Agassiz (overall length 13″ (35 cm), which has a shallowly pyramidal top with three small, hemispherical indentations midway of each side and one at the apex.

In reply to a query, Paul Tolstoy, who has made an exhaustive study of beaters, sent (pers. comm. 12/3/82) sketches of five quadrangular, grooved beaters with pyramidal tops, two of which are Samoan and three Fijian. One from Samoa has a "cup" at its apex. Tolstoy, quoting from his notes, states that of some fifty-nine beaters from Fiji of which he has a record, "about one third have these tops to some degree." He adds that they seem to be most common in Fiji. His examples are all from the American Museum of Natural History, New York. This is interesting in view of the apparent absence of such beaters at either Harvard's Peabody Museum (except one specimen) or the Peabody Museum in Salem. Photographs in Kooijman (1972) and Brigham (1976) sometimes show beaters with faintly rounded heads amid a majority of flat heads. A Tahitian beater (Kooijman 1972; Fig. 2) presents an interesting detail: on a flat top there is carved in low relief a four-sided shape, the four sides of which are directed to the corners of the beater; this could suggest a transitional form between the flat and the pyramidal top.

Brigham's painstaking attention to detail in his description of bark cloth beaters and their use answers a natural question: why did not the grooves of beaters fill up with the soft pulp of beaten fibers? The fact is that they did become so clogged, and Brigham illustrates an instrument formerly used in Hawaii to ream out the grooves (Fig. 46, 4043 and Fig. 47). So few of these "de-cloggers" have survived, however, that he adds, "it may well be supposed that a sharp stick or edge of bamboo were the more common cleaners."

Of the tools and techniques associated with the making of bark cloth in Polynesia, beaters are the most constant in character. They may be made of any of several very hard woods (a favorite is *Casuarina equisetifolia*). They may vary an inch or so in an average length of some 17 inches (40 cm). The four sides of the beating end may be provided with varying numbers of grooves, spaced closely or widely apart. Beating end and/or handle may flare somewhat. There are exceptions: in ancient times, some beaters were club-shaped, and it is reported that a very occasional three-sided beating end has appeared. All in all, however, a beater always may be recognized for what it is and for what its use may be.

Because the beater is the essential agent in the transformation of the inner bark of certain trees into bark cloth, it is an ideal point of departure for a summary of bark cloth as a distinguishing trait of the material culture of Polynesia past and, to some degree, present. Bark cloth is known in the lingua franca of the South Pacific as tapa. The etymology of the word (spelled kapa but pronounced tapa in Hawaii) is ka (the) and pa (beaten or the beaten thing). Emery (1966) in her description, prefaces bark cloth with "pounded." Bark cloth has many local names in Oceania, depending on the islands of its manufacture (e.g. siapo, Samoa; masi, Fiji; ngatu, Tonga; ahu, Tahiti). In some cases, both the source tree and the cloth have the same name. In Polynesia, the three trees most utilized are *Broussonetia papyrifera*, (not native, always cultivated); *Artocarpus altilis*, (not native, cultivated for food as well as for bark cloth); *Ficus* spp. (growing wild in the Pacific). Notably in Hawaii, the inner bark of other plants was once used. A *Pipturus* species and *Hibiscus tiliaceus* are especially mentioned. The inner bark of *Broussonetia papyrifera* was invariably and everywhere preferred as the source of the best quality of bark cloth and the one always used for purposes associated with rank and ceremony.

Planting, cultivating and harvesting the material for bark cloth is man's work. Once the material is provided, all the rest of the labor of making bark cloth is woman's work, with rare exceptions when men make cloth for a special occasion under conditions of taboo and other traditionally imposed restrictions.

To summarize: the making of bark cloth in Polynesia varies in details that defy generalization. In Kooijman's comments with supplementary notes on the pieces in the Botanical Museum's collection, only the pertinent among these details are described. There are many more, equally significant and equally widespread, among which are the following: of dyeing methods used in painting characteristic patterns; of joining pieces by pasting or felting; of the use of design tablets and rubbing on colors; of the occasional scenting of bark cloth to counteract a somewhat unpleasant odor (especially of newly made cloth); of the use of glazes to preserve colors or to provide a measure of waterproofing.

Kooijman (1972 and 1977) sums up variants of technique in both text and a series of tables. Both Brigham (1976) and Degener (1975) contribute ethnobotanical data that by necessity Kooijman does not include in his more specialized approach.

Wrote Rudyard Kipling:

> There are nine and sixty ways
>   of constructing tribal lays,
> Any every-single-one-of-them
>   -is-right!

—and he could well have been writing, instead, of the nine and sixty ways and many more, of "constructing" bark cloth in Polynesia.

ACKNOWLEDGMENTS

The manufacture and uses of bark cloth by the island dwellers of the South Pacific constitute a culture trait that although it displays marked similarities among island clusters also shows enough important differences to preclude unqualified description.

I was fortunate that, in answering a query about his *Tapa in Polynesia*, Professor Simon Kooijman of the Rijksmuseum voor Volkenkunde, Leiden, offered to give me his opinion of the provenance of eight undocumented pieces of bark cloth in the Botanical Museum. He used references from his *Tapa in Polynesia* and his *Tapa on Moce Island, Fiji*. I owe a very great debt to Professor Kooijman, who so generously shared his scholarly skills with a stranger. Professor Kooijman examined color slides from photographs taken by Dr. Anna C. Roosevelt of the Museum of the American Indian, New York, and by Scott E. Wilder, Curatorial Assistant in the Botanical Museum, Harvard University. My grateful thanks go to these two photographers.

I wish to record a special obligation to Richard Evans Schultes, Jeffrey Professor of Biology and Director of the Botanical Museum, Harvard University. I have depended, during many months of research and writing, on his unfailing interest and on his invaluable help in solving botanical problems.

In the initial stages of my research, I received background information on Pacific cultures from Dr. Monni Adams of the Peabody Museum, Harvard University. For this and for other kindnesses, I thank her sincerely.

For assistance during the course of my study, I wish to express my gratitude to the following people, from whose experience and knowledge I have greatly benefited:

—to Dr. Paul Tolstoy, for comments on and drawings of tapa beaters similar to the one in the Botanical Museum collection, an example of which I had not succeeded in locating, except for a somewhat similar beater at the Peabody Museum, Harvard University; also for a copy of his monograph on cultural parallels in the manufacture of bark cloth that will enrich my resources in completing Part 2 of this study;

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Last, but really first, my husband, Maurice, must receive my gratitude for his steady encouragement throughout the accomplishment of a piece of work the difficulties of which neither he nor I anticipated. I have depended especially on his geological and geographical knowledge of Oceania.

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PLATE 13

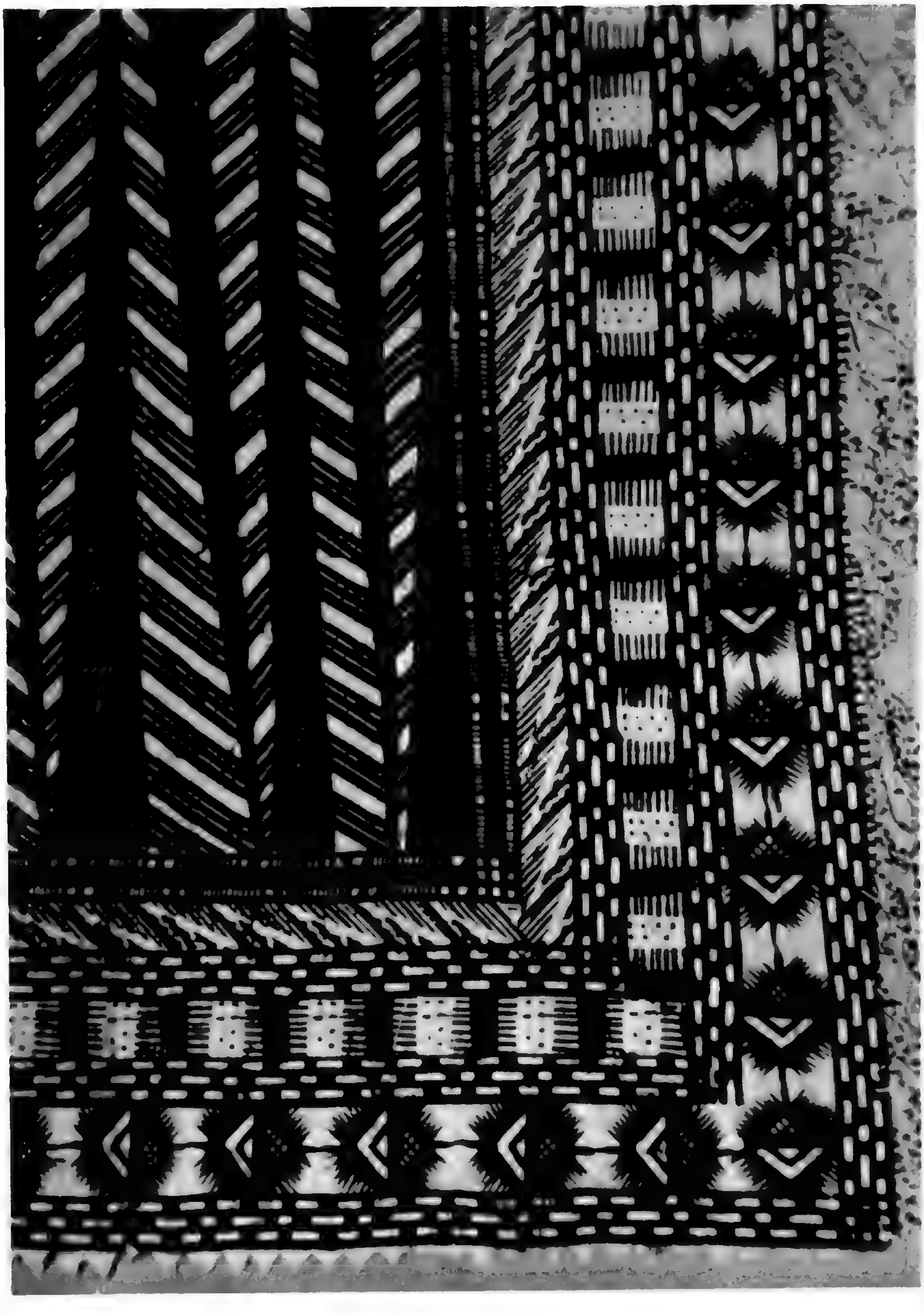

Plate 13. Illustrating a popular motif, the so-called "hairy diamonds".

PLATE 14

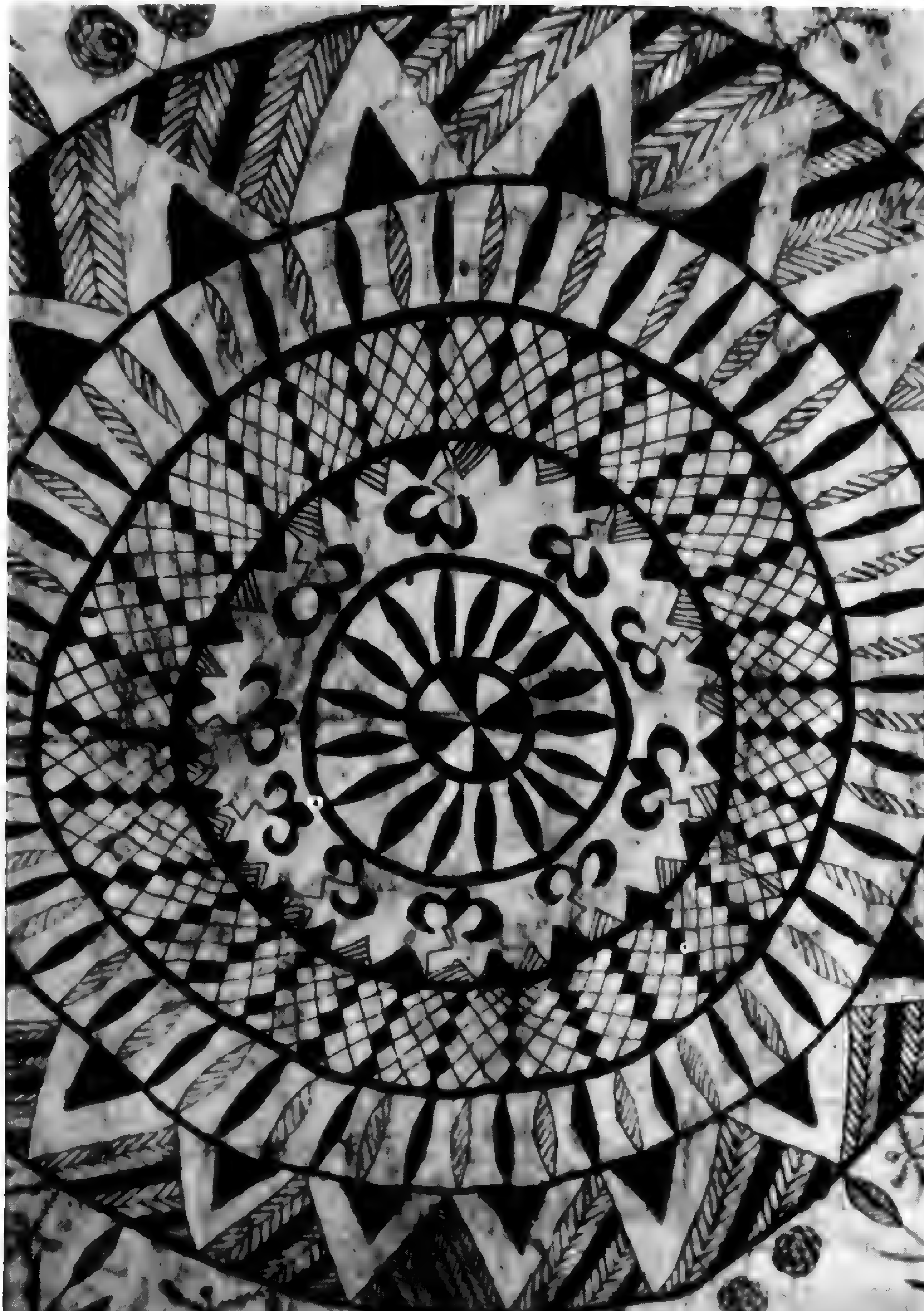

Plate 14. Illustrating an unidentified motif repeated in a circular pattern; perhaps a stingray with zigzag tail.

A NEW SPECIES OF LEPECHINIA WILLD. (LAMIACEAE)

JEFFREY A. HART

A systematic revision of the genus *Lepechinia* which consists of 36 species has recently been completed by me. Most of the species are native to tropical and subtropical highlands of Latin America with the exception of four species which occur in California, U.S.A.

While visiting the Ecuadorian highlands during my last collecting trip, around Vilcabamba I came upon another, yet undescribed species. The flowers of this new plants appear to be rather small when compared with the other members of the Section *Parviflorae*, which is restricted to andean South America, where these new plants belong. As a matter of fact, the size of the corollas, as noted, are the smallest in the entire genus. The plants are dioecious; the female (pistillate) flowers have somewhat larger calyces and smaller corollas than do the male (staminate) flowers.

Lepechinia dioica Hart, *sp. nov.*

L. mutica et *L. mollis* affinis sed foliis basi decurrentibus, calycibus constrictis distalibus, et inflorescentiis ramosissimis. Type: near Vilcabamba, Ecuador, 1700 m, *Hart 1983* (holotype, GH!).

Shrubs 1–2 m tall. Leaf blades (Figure 1 A) narrowly ovate, (4.0–)4.5–12.0(–14.7)×(1.4–)2.0–3.8(–4.4) cm, L/W ratio 2.5–3.9; apices acute; bases obtuse and decurrent; margins serrate; adaxial surfaces (Figure 1 B) bullate, bullae 0.4–1.2 mm across, rounded and densely tomentose on top, sessile glandular hairs; abaxial surface densely pubescent. Petioles 0.5–1.8 cm long, villose. Inflorescence axes (4.8–)8.0–22.0 cm long, 5– to 9– (to 11–) branched, lowermost branch 0.4–0.6 times the length of the axis; verticillasters interrupted; floral leaves oval, 1.3–2.1 mm long, not exceeding the flowers in length, upper floral leaves caducous above; pedicels 0.3–0.4 mm long. Dioecious. Calyces at anthesis

1.7–2.6 × 1.3–1.6 mm, teeth acute, 0.3–0.8 mm long. Staminate plants: corolla 2.1–3.2 × 0.9–1.5 mm, abaxial lobe 0.7–1.7 mm long, other lobes 0.4–0.6 mm long, pilose patch between abaxial filaments (sparse to absent); filaments 0.4–0.9 mm long, anthers 0.3–0.4 mm long; ovaries 0.2–0.4 mm long, style 1.3–1.7 mm long, stigmas ca. 0.2 mm long; nutlets at most 0.2–0.4 mm long; calyx 3.4–4.5 mm long. Pistillate plants: corollas 1.7–2.7 × 0.8–1.1 mm, abaxial lobe 0.5–0.9 mm long, other lobes 0.3–0.4 mm long, pilose patch between abaxial filaments (sparse to absent); filaments ca. 0.2 mm long, anthers ca. 0.2 mm long; ovaries 0.3–0.4 mm long, style 1.3–2.2 mm long, stigmas ca. 0.2 mm long. Fruiting calyces (Figure 1 C) yellowish green to brown and slightly purplish tinged, subbilabiate, tube constricted distally, adaxially 3.4–4.8 mm long, abaxially somewhat shorter, tube 1.7–2.2 mm wide, teeth acute, the adaxial 0.3–0.6(–0.9) mm and the abaxial 0.4–0.9 mm long; veins 5 (to 7). Nutlets maturing to 1.8 mm long.

DISTRIBUTION AND ECOLOGY. Southern Ecuador (Figure 1 D); dry terrain alongside roads and in disturbed secondary vegetation; 1700–2300 m; flowering from May through July.

REPRESENTATIVE SPECIMENS. Ecuador. Loja: near Vilcabamba, 2300 m, *Hart 774* (GH); 1760 m, *Hart 1276* (GH); near Vilcabamba, 1700 m, *Hart 1983* (GH) Holotype!; near Quilanga, 2280 m, *Hart 1358* (GH).

Lepechinia dioica is a distinctive species recognized by its leaves which are lanceolate to ovate-lanceolate, have obtuse and long decurrent bases, and are densely and minutely pubescent on the adaxial surfaces; highly branched inflorescences with 5 to 8 secondary branches and caducous floral leaves; small fruiting calyces whose tubes are constricted distally; very small teeth 0.4–0.9 mm long, and 5 (to 7) veins; the tiny corollas 2.1–2.7 mm long; and dioecious breeding system. The epithet "*dioica*" alludes to the breeding system.

Lepechinia dioica is most closely related to *L. mutica* and *L. mollis*, and shares with them densely tomentose, ovate leaves with acute bases. It differs from them by its decurrent leaf bases; distally constricted, slightly purplish, much fewer 5- (to 7-) veined mature calyces; and generally more highly branched inflorescences.

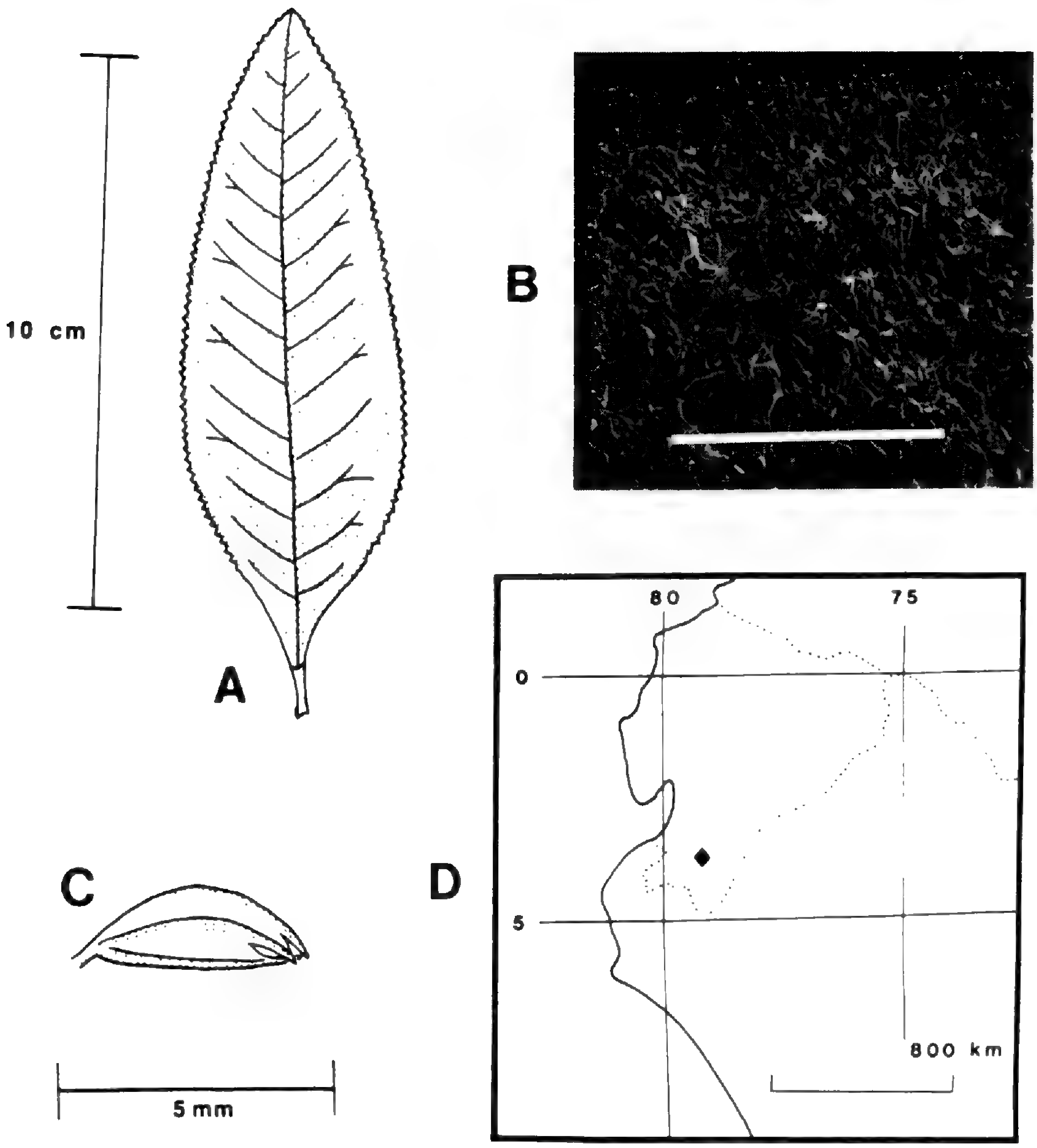

Figure 1. Distribution map and diagnostic characters of *Lepechinia dioica*. A, Leaf (*Hart 1983*); B, Adaxial leaf surface (*Hart 1983*) (bar = 1000 mu); C, Fruiting calyx, lateral view (*Hart 1983*); D, Distribution map.

LITERATURE CITED

Hart, J. A. 1983. Systematics and evolution in the genus *Lepechinia* Willd. (Lamiaceae). Ph.D. dissertation. Harvard University.

Hart, J. A. 1984. Evolution of dioecy in *Lepechinia* Willd. Section *Parviflorae*. (Submitted for publication).

FRANK W. HANKINS (1897–1983): AN APPRECIATION

Ralph H. Wetmore

During the academic year of 1958–59, Mr. Frank W. Hankins of Alpine, Texas made his first appearance at the laboratory of Professor Elso S. Barghoorn at Harvard University. He had heard of the Harvard Wood Collection and was seriously interested. Professor Barghoorn was obviously intrigued by the discussion and increasingly so for Mr. Hankins wanted to return and to maintain definite relations with him and with the Wood Collection. Professor Barghoorn encouraged this relationship, since Mr. Hankins had retired from his consulting business in Texas and was investigating possible fields in which he might direct his efforts as a major concern. Having already visited other wood laboratories in the United States, he established a technical laboratory at Sul Ross State University in Alpine, Texas, and recruited staff members to permit progress in acquiring knowledge in the study of wood.

For twenty-five years (1958–1983) he maintained his association with Professor Barghoorn and the Harvard Wood Collection, returning to Harvard each year for varying periods of time, for discussions and reporting progress. For two years he was appointed as a member of the Visiting Committee for Biology of the Harvard Board of Overseers and attended the joint meetings of this committee with the Harvard Faculty of Biology. During this period, Mr. Hankins maintained a very concerned, interested and informed relationship with the Harvard Wood Collection and its staff. He established a collection of wood samples from trees and shrubs of Gymnosperms and Angiosperms in his own laboratory and built up a small staff at the local college, Sul Ross State University, in Alpine, Texas. He made microscopic wood slides or made connections with competent staff members at other universities where excellent microscopic slides could be prepared and initially evaluated. These slides and those made anew from documented wood blocks gathered from various xylaria, were then examined by Mr. Hankins himself, and on his regular visits to Professor Barghoorn these slides were added to the Harvard Wood Collection. Mr. Hankins and his staff added greatly to the Harvard Wood Collection through his contributions of microscopic slides of woods made from blocks from Harvard's collection, from his personal collection, and those made for him by his collaborators at other institutions.

Mr. Hankins' recent death on October 9, 1983, has resulted in the addition of the entire Frank W. Hankins collection—of correspondence files, data files, wood anatomical identification "keycards" and microfiche thereof, wood blocks, and prepared microscopic slides—to the Harvard Wood Collection.

Those responsible for the Harvard Wood Collection, and the staff and students of Harvard's Department of Organismic and Evolutionary Biology always will be grateful for the significant contribution of Frank Hankins and his staff in Alpine, Texas, and to Mr. Hankins' colleague, Professor Lyman H. Daugherty of San José, California, who completed a large part of the preparation of these microscopic slides donated to the Wood Collection by Mr. Hankins.

For seven years (1976–1983), Mr. Hankins was a member of the Botanical Museum staff as Associate in Paleobotany.

Unfortunately, Professor Barghoorn's unexpected and sudden death on January 27, 1984, leaves the Harvard Wood Collection without an official Supervisor at present. This very warm and appreciative note was written on Professor Barghoorn's behalf.

Botanical Museum Leaflets
Spring 1984 Vol. 30, No. 2

A NEW SPECIES OF PRUNUS FROM COLOMBIA

Richard Evans Schultes and Hernando García-Barriga

This beautiful shrubby species of Prunus from the highland area of central Colombia has been introduced to cultivation in the gardens of the Instituto de Ciencias Naturales of the Universidad Nacional in Bogotá. We believe that it is worthy of more generalized use as an ornamental in regions appropriate for its growth.

We take great pleasure in naming this species in honour of His Excellency, Dr. Belisario Betancur, President of the Republic of Colombia, in recognition of his long interest in the furtherance of investigations in the natural sciences in his country.

Prunus Betancurii *R. E. Schultes et H. García-Barriga* spec. nov.

Frutex debilis, usque ad 10 ped. altus, leviter ramosus. Folia ramique juvenales rubelli. Ramuli abundantis cum lenticellis ornati. Folia viridia, firme papyracea, elliptica, base rotundata, apice plerumque obtuse et breviter acuminata, non marginata, margine vivo undulata, siccitate 4.5–6.5 cm. longa, 2.5–3.5 cm. lata, supra nitidula, nervo centrale bene impresso, infra pallida, nervo centrale valde elevato; petiolus 4–5 mm. longus. Inflorescentiae axillares, 4–6 cm. longae, praeter partem basilarem multiflorae. Flores: pedicellus comparate robustior, 3–4 mm. longus; calyx viridulus, crassus, tubo 2 mm. longo, glabro, lobis 1 mm. longis, triangularibus, acutis; petala alba sed basi rosea, membranacea, vivo paullo cucullata, rotundata, margine plus minusve irregulares, plerumque 3 mm. longa, 2.5–3 mm. lata; stamina flava, usque ad 1.8 mm. longa, filamentis basi paullo dilatatis, antheris conspicuis, variabiliter 0.8 mm. longis; ovarium elongatum, gratatim ad stylum contractum, basi 0.8 mm. in diametro; stylo brunneolo (ovario cum stylo usque ad 4 mm. longo); stigma conspicuum carnosum, capitatum, 0.5 mm. latum. Fructus carnosus, globosus, apice breviter rostellatus, 8–10 mm. in diametro.

COLUMBIA: Departamento de Cundinamarca, Chocontá, El Sisga. Alt. 8600 feet. Cultivated in the gardens of the Instituto de Ciencias Naturales, Ciudad Universitaria, Bogotá. December 17, 1983. *H. García-Barriga* 21366. Type in Herb. Nac. Col. No. 254420; duplicate type in Herb. Gray. Same locality, December 2, 1982. *García-Barriga 21345* (Herb. Nac. Col. 236660).

Prunus Betancurii appears to be related to *P. Moritziana* Koehne and *P. ocellata Koehne*, both from highland Colombia. From the former, it can be distinguished by its longer and less dense inflorescences with much slenderer axes and shorter and weaker pedicels; furthermore, its leaves are not conspicuously marginate. It differs from the latter species by having longer inflorescences (2–3 cm. in *P. ocellata*, 4–6 cm. in *P. Betancurii*) which are much more densely flowered; furthermore, its leaves are obtuse or occasionally very short-acuminate as opposed to the long and conspicuously acuminate leaves of *P. ocellata*. The leaves of *P. Betancurii* in life are strongly undulate, whereas in the other two species the leaves appear to be more or less flat.

PLATE 15

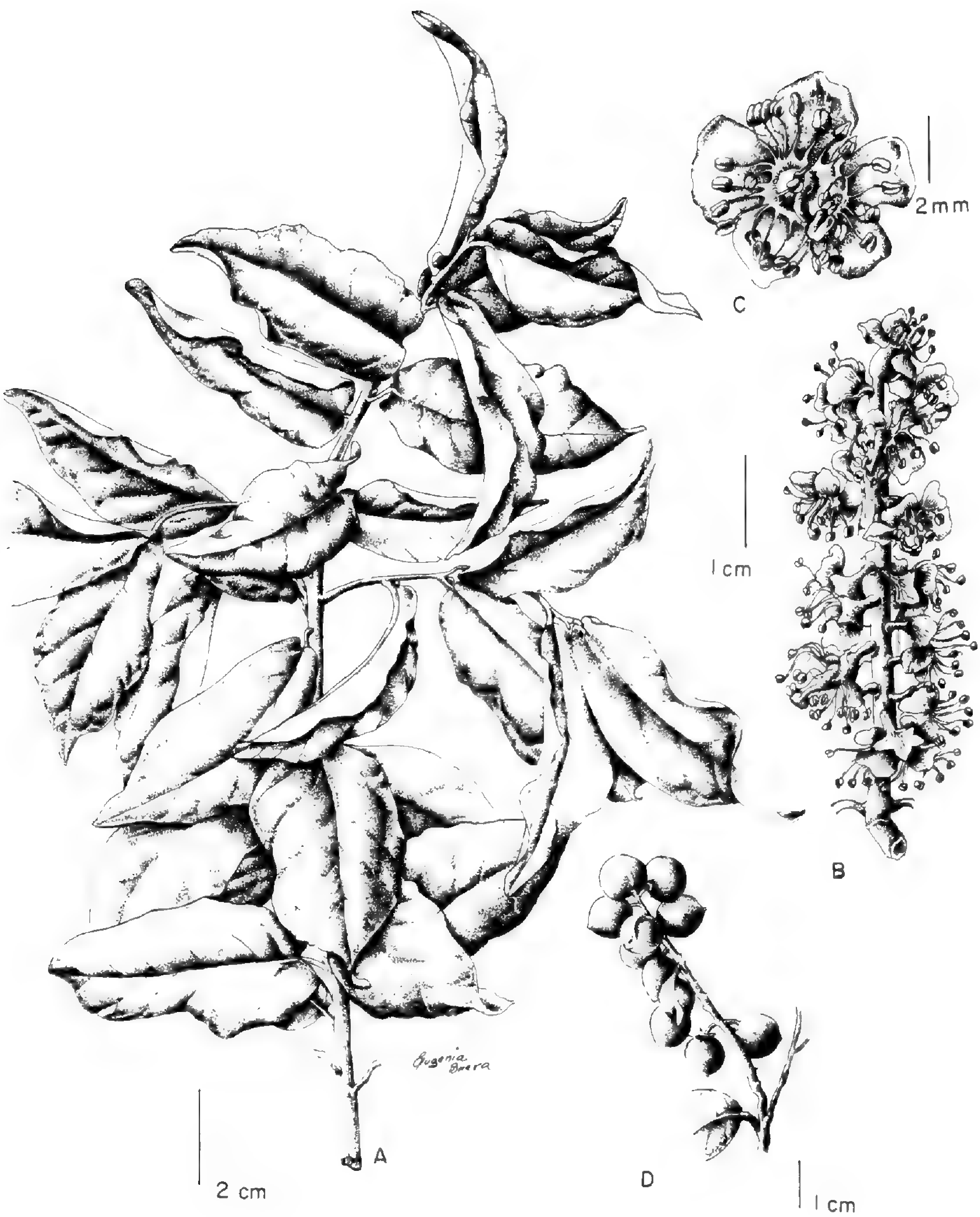

Plate 15. **Prunus Betancurii** R. E. Schultes et. H. García-Barriga

NOTES ON THE ORCHID FLORA OF NEW GUINEA I.

WALTER KITTREDGE

The following nomenclatural and taxonomic notes are presented as a precursor to a checklist of the orchids of New Guinea currently under preparation. In this first part new generic records as well as new combinations are included. Subsequent parts will include typifications of various sectional names and descriptions of new species. The arrangement of genera follows the system presented by Schlechter in his "Die Orchidaceen von Deutsch-Neu-Guinea", published in Fedde, Repertorium specierum novarum regni vegetabilis Beihefte 1: 1–1042, 1911–1914.

Peristylus Turneri (Rogers) Kittredge, *comb. nov.*
Basionym: *Habenaria Turneri* Rogers, Roy. Soc. S. Austr. 49: 254, 1925.

Anoectochilus papuanus (Schltr.) Kittredge, *comb. nov.*
Basionym: *Eucosia papuana* Schltr., Fedde, Rep. Beih. 1:76, 1911.

This is one of several peloric species which Schlechter failed to place correctly. While the peloric lip, lacking a spur, somewhat obscures its generic affinities, this species can definitely be assigned to *Anoectochilus*. The habit of closely-spaced, ovate, short-petiolate leaves and few-flowered inflorescence of large flowers is entirely that of *Anoectochilus*, as is the column with its large bifid rostellum placed well behind the two lateral stigmas, and the long Y-shaped pollinarium with a small visicidium. Previous records of *Anoectochilus* from New Guinea have been identified as species of *Macodes*.

PNG — Madang Prov., Kani Mts., 1000 m., *Schlechter* 17361 (AMES!). Morobe Prov., Menyamya Subprov., Piwi'anga, 2000 m., *Streiman & Kairo* NGF 35902 (AMES!).

Erythrodes bicalcaratus (Rogers & White) Kittredge, *comb. nov.*
Basionym: *Physurus bicalcaratus* Rogers & White, Trans. Roy. Soc. S. Austr. 44:110, 1920.

Malaxis cirrhiflora Kittredge, *nom. nov.*
Basionym: *Microstylis stenophylla* Schltr., Fedde, Rep. Beih. 1:119, 1911, not *Malaxis stenophylla* Holttum.

Malaxis cyanobrachis (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis cyanobrachis* Schltr., Fedde, Rep. 17:371, 1921.

Malaxis dolichostachya (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis dolichostachya* Schltr., Bot. Jahrb. 58:59, 1922.

Malaxis euantha (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis euantha* Schltr., Fedde, Rep. 16:43, 1919.

Malaxis foliosa Kittredge, *nom. nov.*
Basionym: *Microstylis graciliscapa* Schltr., Fedde, Rep. 16:107, 1919, not *Malaxis graciliscapa* Ames & Schweinfurth.

Malaxis gibbosa (J. J. Sm.) Kittredge, *comb. nov.*
Basionym: *Microstylis gibbosa* J. J. Sm., Bull. Dept. Ag. Ind. Ned. 19:28, 1908.

Malaxis integrilabia (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis integrilabia* Schltr., Fedde, Rep. 16:108, 1919.

Malaxis Kempfii (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis Kempfii* Schltr., Fedde, Rep. 16:108, 1919.

Malaxis Keysseri (Mansfeld) Kittredge, *comb. nov.*
Basionym: *Microstylis Keysseri* Mansfeld, Bot. Jahrb. 62:463, 1929.

Malaxis Ledermannii (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis Ledermannii* Schltr., Bot. Jahrb. 58:60, 1922.

Malaxis pubicallosa (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis pubicallosa* Schltr., Fedde, Rep. 17:372, 1921.

Malaxis Stolleana (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis Stolleana* Schltr., Bot. Jahrb. 58:62, 1922.

Malaxis vinosa (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis vinosa* Schltr., Bot. Jahrb. 58:62, 1922.

Malaxis Werneri (Schltr.) Kittredge, *comb. nov.*
Basionym: *Microstylis Werneri* Schltr., Fedde, Rep. 17:373, 1921.

Gynoglottis palaelabellatum (Gilli) Garay & Kittredge, *comb. nov.*
Basionym: *Coelogyne palaelabellatum* Gilli, Ann. Nat. Mus. Wien 84B:22, 1983.

The genus *Gynoglottis* J. J. Sm. was established for a Sumatran species originally described by Reichenbach as a *Coelogyne*. The unique habit of Gilli's plant and the unusual long claw of the lip identify it as being congeneric with *G. cymbidioides* (Reich.f.) J. J. Sm. of which I have examined the type. This new record for New Guinea confirms a wider range for the genus first indicated by the doubtful material from the Moluccas.

Dilochia celebica (Schltr.) Schltr., Fedde, Rep. 21:143, 1925.

This new record extends the range of the genus eastwards to include New Guinea. The specimen was originally distributed as a *Dendrobium*.

IJ-Vogelkop Peninsula, Isjon River valley, from Son to Aifatfekaan, 650 m., *Royen & Sleumer* 7842a (AMES!, L).

Cadetia ledifolia (J. J. Sm.) Kittedge, *comb. nov.*
Basionym: *Dendrobium ledifolium* J. J. Sm., Nova Guinea 18:37, 1934.

Diplocaulobium Ridleyanum (Schltr.) Kittredge, *comb. nov.*
Basionym: *Dendrobium Ridleyanum* Schltr., Schum. & Laut. Nachtr. 160, 1905.
Synonyms: *Dendrobium reptans* Ridley, Journ. Bot. 24:323, 1886, not Swartz 1805, or Fr. & Sav. 1878.
Dendrobium humifusum Krzl., Pflanzenr. Heft 45:280, 1910.

Diplocaulobium gracilicolle (Schltr.) Kittredge, *comb. nov.*
Basionym: *Dendrobium gracilicolle* Schltr., Fedde, Rep. 16:112, 1919.

Trichotosia brachybotrya (Schltr.) Kittredge, *comb. nov.*
Basionym: *Eria brachybotrya* Schltr., Fedde, Rep. 16:115, 1919.

Trichotosia Gjellerupii Kittredge, *nom. nov.*
Basionym: *Eria integra* J. J. Sm., Bull. Jard. Bot. Buit. ser. 2, 3:14, 1912.
Synonym: *Trichotosia integra* (J. J. Sm.) Hunt, Kew Bull. 26:180, 1971, not Ridley 1917.

Trichotosia hapalostachya (Schltr.) Kittredge, *comb. nov.*
Basionym: *Eria hapalostachya* Schltr., Fedde, Rep. 16:218, 1919.

Agrostophyllum neoguinense Kittredge, *nom. nov.*
Basionym: *Chitonochilus papuanum* Schltr., Schum. & Laut. Nachtr. 134, 1905, not *Agrostophyllum papuanum* Schltr.

This species belongs in Schlechter's section *Dolichodesme*, and is most closely related to *A. paniculatum* J. J. Sm. As in *A. stenophyllum* Schltr., another peloric species of the same section, the lip callus is strongly reduced. The flat stems with distichous leaves, ligulate dark-margined leaf sheaths and wiry bracts at the base of the inflorescence are all characteristic of *Agrostophyllum*, while the cluster of elongated racemes with small closelysheathing, tubular bracts is identical in structure with the inflorescence of *A. paniculatum*. Schlechter's drawing of the ventral side of the column is misleading, because the lateral view shows the column to be bowed out in front as is the case in most species of *Agrostophyllum*. The anther contains eight pollinia, not four, as noted by Schlechter, leaving no characters by which to separate *Chitonochilus* from *Agrostophyllum*.

PNG, East Sepik Prov., Torricelli Mts. near Apur, 800 m., *Schlechter* 14420 (AMES!, Isotype).

Bulbophyllum crenilabium Kittredge, *nom. nov.*
Basionym: *Bulbophyllum pictum* Schltr., Fedde, Rep. Beih. 1:758, 1913, not Par. & Rchb. f. 1874

Bulbophyllum densibulbum Kittredge, *nom. nov.*
Basionym: *Bulbophyllum cylindrocarpum* Schltr., Fedde, Rep. 16:122, 1919, not Frappier ex Cordem. 1895.

Bulbophyllum gracilicaule Kittredge, *nom. nov.*
Basionym: *Bulbophyllum erectum* Rolfe, Trans. Linn. Soc. Bot. 9:186, 1916, not Thou. 1822.

Bulbophyllum kenejiense Kittredge, *nom. nov.*
Basionym: *Bulbophyllum hydrophilum* Schltr., Fedde, Rep. Beih. 1:843, 1913, not J. J. Smith 1905.

Bulbophyllum leptophyllum Kittredge, *nom. nov.*
Basionym: *Bulbophyllum lonchophyllum* Schltr., Fedde, Rep. 16:123, 1919, not Schltr. 1913.

Bulbophyllum ligulatum Kittredge, *nom. nov.*
Basionym: *Bulbophyllum eublepharum* Schltr., Fedde, Rep. 16:122, 1919, not *Bulbophyllum eublepharon* Rchb. f. 1862.

Bulbophyllum microlabium Kittredge, *nom. nov.*
Basionym: *Bulbophyllum parvilabium* Schltr., Fedde, Rep. 16:126, 1919, not Schltr. 1911.

Bulbophyllum minutibulbum Kittredge, *nom. nov.*
Basionym: *Bulbophyllum serpens* Schltr., Fedde, Rep. Beih. 1:804, 1913, not Lindley 1830.

Bulbophyllum obtusilabium Kittredge, *nom. nov.*
Basionym: *Bulbophyllum rhizomatosum* Schltr., Bot. Jahrb. 58:131, 1923, not Ames & Schweinf. 1920.

Bulbophyllum planifolium Kittredge, *nom. nov.*
Basionym: *Bulbophyllum breviscapum* J. J. Sm., Bull. Dept. Ag. Ind. Ned. 39:2, 1911, not (Rolfe) Ridley 1907.

Bulbophyllum rubromaculatum Kittredge, *nom. nov.*
Basionym: *Bulbophyllum nigrescens* Schltr., Fedde, Rep. Beih. 1:839, 1913, not Rolfe 1910.

Bulbophyllum sepikense Kittredge, *nom. nov.*
Basionym: *Bulbophyllum cuspidipetalum* Schltr., Bot. Jahrb. 58:132, 1923, not J. J. Sm. 1908.

Bulbophyllum singuliflorum Kittredge, *nom. nov.*
Basionym: *Bulbophyllum nemorosum* Schltr., Fedde, Rep. Beih. 1:884, 1913, not Cogn. 1902.

Bulbophyllum tristelidium Kittredge, *nom. nov.*
Basionym: *Bulbophyllum tridentatum* Rolfe, Kew Bull. p. 128, 1907, not Krzl. 1901.

Monomeria digitata (J. J. Sm.) Kittredge, *comb. nov.*
Basionym: *Bulbophyllum digitatum* J. J. Sm., Bull, Jard, Bot. Buit, ser. 2, 2:18, 1911.

The transfer of this species to *Monomeria* makes J. J. Smith's monotypic section *Gongorodes* a synonym of the genus, which is recorded here from New Guinea for the first time.

Octarrhena bilabrata (Royen) Kittredge, *comb. nov.*
Basionym: *Kerigomnia bilabrata* Royen, Contr. Herb. Austr. 12:2, 1976.

An examination of mature buds from the Ames isotype reveals that there are eight unequal pollinia in the anther, not two as reported by Royen, confirming his original placement of this species in the Thelasiinae. There are five species in *Octarrhena* which share with *O. bilabrata* the eight unequal pollinia and the unusual protruding column, but which differ in habit, having long multiflowered inflorescences.

PNG, Eastern Highlands Prov., Goroka Subprov., near Kerigomna camp, 3000 m., *Hoogland & Pullen* 5525 (AMES!, L! Isotypes).

The following key is offered to differentiate the species related to *Octarrhena bilabrata*:

1. Inflorescences short, 4–8 mm long, 1–3-flowered **O. bilabrata**
1a. Inflorescences longer, 2–9 cm in length, many-flowered . . . 2
2. Lip adnate to column pouch in lower half . . **O. calceiformis**
2a. Lip free from column 3
3. Lip linear-ligulate . . . . **O. cucullifera**
3a. Lip broader, ovate, oblong or triangular 4
4. Inflorescence 1, subterminal, peduncle long, ovary smooth to slightly rugulose . . . . **O. obovata**
4a. Inflorescence(s) 1–many, axillary from any part of stem, peduncle short, ovary warty 5
5. Leaves 8–15 mm long, petals obtuse to truncate. . . **O. gracilis**
5a. Leaves 17–25 mm long, petals acute . . . . . . **O. cupulilabra**

Octarrhena teretifolia (Gilli) Kittredge, *comb. nov.*
Basionym: *Dendrochilum teretifolium* Gilli, Ann. Nat. Mus. Wien 84B:31, 1983.

This species is closely allied to *O. arfakensis* J. J. Sm. and *O. cylindrica* J. J. Sm. from which it differs in having orbicular petals and an invagination at the apex of the lip calli.

PNG, Western Highlands Prov., Laiagam, 2850 m., *Gilli* 461 (W! Holotype).

Thelasis abbreviata (Schltr.) Kittredge, *comb. nov.*
Basionym: *Oxyanthera abbreviata* Schltr., Fedde, Rep. Beih. 1:906, 1913.

Thelasis papuana (Schltr.) Kittredge, *comb. nov.*
Basionym: *Oxyanthera papuana* Schltr., Schum. & Laut. Nachtr. p. 126, 1905.

In describing the peloric form of *Thelasis carinata* Bl. in Nova Guinea 14:492, 1929, J. J. Smith stated that *Oxyanthera papuana* should be regarded as a synonym of *T. carinata*. An examination of Schlechter's collections reveals two prominent differences between these species which merit their separation. The first, mentioned by Schlechter, is that the flowers of *T. papuana* are nearly twice as large as those of *T. carinata*. The second is that *T. papuana* has a pair of stelidia at the apex of the column which are absent in *T. carinata*.
PNG: Bismarck Mts., 350 m., *Schlechter* 18658 (AMES!).

Phreatia clivicola Kittredge, *nom. nov.*
Basionym: *Phreatia collina* Schltr., Fedde, Rep. Beih. 1:9191, 1913, not J. J. Sm. 1911.

ANATOMY OF NONCOSTAL PORTIONS OF LAMINA IN THE CYCLANTHACEAE (MONOCOTYLEDONEAE). *V*. TABLES OF DATA

GEORGE J. WILDER*

This is the last paper of a series which pertains to lamina anatomy in the Cyclanthaceae (Wilder, in press a, b, c, d). Each paper is based on the same fifty-three species and ten genera of the family. Collection localities have been listed (Tomlinson and Wilder, 1984). The present paper includes tables which document findings in all previous papers of the series. Tables are organized into four groups representing paper nos. *I–IV* of the series, respectively. Each group of tables is introduced by a synopsis of the paper which it represents.

INTRODUCTION TO TABLES 1–6
(Wilder, in press *a*)

The outer walls of ordinary epidermal cells exhibit inner noncutinized and outer cutinized regions, and are covered by a cuticle sensu stricto (Table 1). Noncostal portions of cyclanthaceous laminae are always hypostomatic, i.e., having the majority of stomata situated in the abaxial epidermis (Tables 2, 3). In noncostal parts of this epidermis, stomata are oriented within stomatal bands, and such bands are separated by interstomatal bands of four main kinds: (*1*) in interridge areas, bands located over superficially situated fiber strands of the mesophyll, (*2*) also in interridge areas, bands situated over the largest longitudinal veins, (*3*) bands occurring on abaxial ridges, and (*4*) bands of epidermal expansion tissue. Given a small strip of epidermis, it is sometimes possible to ascertain the following: whether it is adaxial or abaxial; if abaxial, whether portions thereof are from interridge areas, ridges, or expansion tissue, and

*Harvard Forest, Harvard University
Petersham, Massachusetts 01366
Present address: Cleveland State University, Dept. of Biology, 1983 East 24th Street, Cleveland, Ohio 44115

which portions from interridge areas occur over fiber strands and the largest veins; which are the abaxial and adaxial sides of the strip; which are its distal and basal ends, and its left and right sides relative to the lamina it came from. A cyclanthaceous stoma is normally encircled by four subsidiary cells, and the stoma and associated subsidiary cells are collectively called a stomatal complex (Tables 4–6). Subsidiary cells may differ from ordinary epidermal cells in numerous ways such as their shape and position, nature of inclusions, staining of outer cell walls, size of nuclei, and thickness and ornamentation of the cuticle. In four species the stomata exhibit polar perforations, i.e., large pores located within the distal and basal ends of the common wall between two associated guard cells. Cyclanthaceous stomata exhibit substantial dorsiventral symmetry.

TABLE 1.

GENERAL RANGE IN COMBINED THICKNESS OF CUTICLE AND CUTINIZED REGION (rounded off to nearest quarter micrometer)

Species	*Adaxial epidermis*	*Abaxial epidermis*
A. aff. *A. antioquiae* (coll. A)	0.75– 1.5	0.5 – 2
A. aff. *A. antioquiae* (coll. B)	1 – 1.5	0.5 – 1
A. cabrerae	2 – 3.25	0.75– 2.5
A. cayapensis	1.5 – 2.5	0.5 – 2
A. sp. nov. aff. *A. cupulifera* (coll. A)	1 – 1.5	0.5 – 1
A. sp. nov. aff. *A. cupulifera* (coll. B)	3 – 4.75	1 – 3.75
A. gamotepala	3.25– 7.25	1.5 – 6.25
A. hookeri	0.75– 1.5	<0.5 – 0.75
A. longitepala	1.5 – 2.5	0.75– 1.5
A. sp. nov. aff. *A. longitepala*	2.5 – 5.25	1.5 – 4.25
A. moritziana	2 – 3.75	0.75– 3
A. aff. *A. moritzi*	3 – 4.25	1 – 2.5

TABLE 1 *(continued)*

GENERAL RANGE IN COMBINED THICKNESS OF CUTICLE AND CUTINIZED REGION (rounded off to nearest quarter micrometer)

Species	*Adaxial epidermis*	*Abaxial epidermis*
A. sp. nov. aff. *A. multistaminata*	1 - 2.5	0.5 - 1.5
A. peruviana	1.5 4.75	0.5 - 2.5
A. pycnantha	2.5 - 4.5	1 - 3
A. quinindensis	1 2.5	0.5 - 1
A. sp. nov. aff. *A. rhodea*	1.5 - 2.5	0.5 - 2
A. rigida	1.5 - 3	0.5 - 1.25
A. tetragona	1.5 3.75	0.75- 1.5
A. urophylla	3 8.75	1.5 - 4.75
A. aff. *A. vaupesiana* (coll. A)	1.5 - 3.25	0.5 - 2
A. aff. *A. vaupesiana* (coll. B)	1.5 - 2.5	0.5 - 1.5
A. (Asplundia) sp. nov.	1 - 3	1 - 3.25
Ca. palmata	3.5 5.5	1 4
Cy. bipartitus	1 - 2	0.5 1.5
D. crinitum	1.5 - 3.5	1 - 2.5
D. dolichostemon	0.5 - 1.5	<0.5 - [illegible].5
D. globosum	1.5 - 2.5	1 3
D. grandifolium	0.5 - 1	0.5 - 2
D. harlingii	<0.5 0.5	<0.5 0.5
D. macrophyllum	1.5 5.75	0.75- 3.25
D. mirabile	0.75 1.5	0.5 - 1.5
D. sp. nov. aff. *D. nanum*	1.5 3	1 - 2.5
D. rheithrophilum	1.5 3.75	1 3.75
D. schultesii	0.75 2.5	0.5 - 3.25
D. wallisii	0.5	0.25 0.5
D. sp. nov. (coll. A)		0.5 - 0.75
D. sp. nov. (coll. B)	0.5 - 1	0.5

TABLE 1 *(continued)*

GENERAL RANGE IN COMBINED THICKNESS OF CUTICLE AND CUTINIZED REGION (rounded off to nearest quarter micrometer)

Species	*Adaxial epidermis*	*Abaxial epidermis*
E. funifer	2.0 - 3.5	1 - 3.5
L. bierhorstii	1 - 3	0.5 1
L. integrifolia	3.75- 6.75	2.5 - 5.25
L. lancifolia	3 - 5	2.5 - 5
Sch. chorianthum	1 - 1.5	<0.5 0.5
Sph. acutitepala	3 - 4.75	1 - 7.25
Sph. crocea	3.25- 7.75	1.5 - 4.75
Sph. killipii	5 - 7.5	0.5 - 3
Sph. snidernii	6.25-13	1 - 3.75
Sph. woodsonii	5.25- 7.25	0.5 - 1
Sph. sp. nov. aff. *Sph. woodsonii*	3 - 5.25	1.5 3.25
Sph. sp. nov.	3.25 6.25	0.5 3
St. anomala	7.75-12	3.75-12
St. stylaris	8.5 -12.5	4 -10.5
T. bissectus	1 - 6.5	1 - 5

TABLE 2

CONCENTRATION OF STOMATA AND LAMINA THICKNESS IN INTERRIDGE AREAS.*

	No. of stomata/mm² in the abaxial epidermis, adaxial epidermis, and both epidermides			Ratio of nos. of stomata/mm² - abaxial:adaxial	Lamina thickness - general range and midpoint of range (mm)	Lamina thickness - in nos. of cell layers
A. aff. *A. antioquiae* (coll. A)	213	4.0	217	53	0.18–0.29; 0.24	11–13
A. aff. *A. antioquiae* (coll. B)	267	2.8	270	95	0.23–0.34; 0.29	12–15
A. cabrerae	108	13	121	8.4	0.41–0.52; 0.46	17 20
A. cayapensis	155	3.1	158	50	0.31–0.45; 0.38	19–22
A. sp. nov. aff. *A. cupulifera* (coll. A)	131	0.31	132	421	0.16–0.20; 0.18	10–15
A. sp. nov. aff. *A. cupulifera* (coll. B)	169	0.31	169	542	0.20–0.29; 0.24	13–15
A. gamotepala	260	9.0	269	29	0.35–0.44; 0.40	16–19
A. hookeri	117	3.1	120	38	0.22–0.29; 0.26**	10–12**
A. longitepala	138	2.5	140	55	0.25–0.36; 0.30	11–14
A. sp. nov. aff. *A. longitepala*	176	5.6	181	31	0.31–0.39; 0.35	15–18
A. moritziana	118	4.7	122	25	0.23–0.29; 0.26	12–16

TABLE 2 *(continued)*

CONCENTRATION OF STOMATA AND LAMINA THICKNESS IN INTERRIDGE AREAS.*

	No. of stomata/mm² in the abaxial epidermis, adaxial epidermis, and both epidermides			Ratio of nos. of stomata/mm² - abaxial:adaxial	Lamina thickness - general range and midpoint of range (mm)	Lamina thickness - in nos. of cell layers
A. aff. *A. moritziana*	269	1.2	270	216	0.20–0.26; 0.23	11–14
A. sp. nov. aff. *A. multistaminata*	144	12	156	12	0.21–0.27; 0.24	11–13
A. peruviana	167	8.3	175	20	0.21–0.27; 0.24	11–12
A. pycnantha	166	4.0	170	41	0.30 0.37; 0.33	16–20
A. quinindensis					0.19–0.26; 0.23	11–13
A. sp. nov. aff. *A. rhodea*	156	0.93	157	167	0.20–0.23; 0.22	11–12
A. rigida	132	5.6	138	24	0.28–0.37; 0.32	14–15
A. tetragona	140	5.6	145	25	0.19–0.24; 0.22	12–15
A. urophylla	207	8.1	215	26	0.24–0.32; 0.28	15–18**
A. aff. *A. vaupesiana* (coll. A)	188	11	199	17	0.23–0.29; 0.26**	12–15**
A. aff. *A. vaupesiana* (coll. B)	107	8.4	116	13	0.30–0.34; 0.32	13–15
A. (Asplundia) sp. nov.	104	3.4	107	30	0.32–0.41; 0.36	12–14

Ca. palmata	269	1.2	270	215	0.18–0.26; 0.22	12–16
Cy. bipartitus	311	41	352	7.6	0.26–0.41; 0.33	14–16
D. crinitum	234	0.93	235	250	0.34–0.43; 0.39	20–27
D. dolichostemon	142	29	170	4.9	0.23–0.31; 0.27	14–16
D. globosum	261	0	261	ca. ∞	0.32–0.37; 0.35	12–14**
D. grandifolium	107	30	138	3.6	0.19–0.26; 0.22	9–12
D. harlingii	108	46	154	2.3		
D. macrophyllum	255	0.31	255	818	0.34–0.45; 0.40	19 21
D. mirabile	165	62	228	2.7	0.23–0.32; 0.28	11–14
D. sp. nov. aff. *D. nanum*	270	26	296	10	0.27–0.33; 0.30	12–14**
D. rheithrophilum	189	19	208	10	0.41–0.48; 0.44	14 18
D. schultesii	151	28	179	5.4	0.19 0.24; 0.22	10–14
D. wallisii	273	22	295	12	0.25–0.28; 0.27	12–15**
D. sp. nov. (coll. A)	71	8.1	79	8.7	0.28–0.33; 0.30	9–11
D. sp. nov. (coll. B)	194	9.0	203	21	0.28–0.36; 0.32	14–16
E. funifer	160	14	174	11	0.17–0.24; 0.20	10–13
L. bierhorstii	59	2.5	61	24	0.26 0.32; 0.29**	10–12**
L. integrifolia	91	26	117	3.5	0.37–0.46; 0.42	12–15
L. lancifolia	44	34	78	1.3	0.47–0.61; 0.54	12 17
Sch. chorianthum	144	0	144	ca. ∞	0.12–0.16; 0.14	8–9

TABLE 2 *(continued)*

CONCENTRATION OF STOMATA AND LAMINA THICKNESS IN INTERRIDGE AREAS.*

	No. of stomata/mm² in the abaxial epidermis, adaxial epidermis, and both epidermides			Ratio of nos. of stomata/mm² - abaxial:adaxial	Lamina thickness - general range and midpoint of range (mm)	Lamina thickness - in nos. of cell layers
Sph. acutitepala	236	0	236	ca. ∞	0.32–0.38; 0.35	15–17
Sph. crocea	164	0.62	164	262	0.29–0.48; 0.39	16–18
Sph. killipii	309	5.6	315	55	0.33–0.38; 0.36	16–18
Sph. snidernii	273	10	283	27	0.28–0.36; 0.32	15–17
Sph. woodsonii	188	0	188	ca. ∞	0.36–0.42; 0.39	16–17
Sph. sp. nov. aff. *Sph. woodsonii*	123	3.7	127	33	0.40–0.45; 0.43	22
Sph. sp. nov.	486	1.9	488	260	0.23–0.32; 0.27	12–14
St. anomala	105	0	105	ca. ∞	0.30–0.41; 0.36**	13–17**
St. stylaris	176	1.9	178	94	0.47–0.61; 0.54	18–22
T. bissectus	227	80	307	2.8	0.33–0.43; 0.38	17–20

*Stomatal frequencies were determined by studying mostly stained, but also unstained epidermal peels with the phase microscope at 100X. Stomata were counted on 3.21 mm² of a peel from each of the abaxial and adaxial epidermides, with the following exceptions (the two figures between each pair of parentheses indicate areas studied [mm²] of the abaxial and adaxial epidermides, respectively): *A. peruviana* (1.81, 1.81), *A. urophylla* (3.01, 3.21), *D. harlingii* (2.01, 3.21), and *D. mirabile* (2.01, 1.61). As often as possible on a peel, fields were studied which were laterally rather than longitudinally adjacent to one another, to maximize randomness of sampling, i.e., to avoid including the same stomatal or interstomatal band(s) in all samples. For certain species the concentration indicated for both epidermides is slightly different from the total of the separate indicated concentrations, because the total was computed and rounded off, prior to rounding off of the separate values. Lamina thickness in mm was determined only for cross sections. Thickness in numbers of cell layers was ascertained, using portions of longitudinal sections containing only epidermal cells and ordinary parenchyma cells.

**These values were obtained from study of unembedded material which was bleached in an aqueous solution of sodium hypochlorite, and mounted in glycerine. Remaining values were determined during study of stained, plastic-embedded material.

TABLE 3

STOMATAL RATIOS IN THE INTERRIDGE AREA*

	Percentage of species with low ratios (0–29)	Percentage of species with moderate ratios (30–99)	Percentage of species with high ratios (100 and higher)
Asplundia (22, 94)	45.5	36.4	18.2
Carludovica (1, 3)		–	100
Cyclanthus (1, 1)	100	–	–
Dicranopygium (13, 48)	76.9	–	23.1
Evodianthus (1, 1)	100	–	–
Ludovia (3, 3)	100	–	–
Schultesiophytum (1, 1)	–	–	100
Sphaeradenia (7, 42)	14.3	28.6	57.1
Stelestylis (2, 4)	–	50	50
Thoracocarpus (1, 1)	100	–	–

*In parentheses after the name of each genus are indicated the number of species considered, and the total number of species known, not including undescribed species collected by the writer.

TABLE 4

PERCENTAGES OF STOMATAL COMPLEXES IN THE ABAXIAL EPIDERMIS IN WHICH NEITHER, ONE, OR BOTH NONPOLAR SUBSIDIARY CELL(S) EXTEND(S) TO THE OUTER EDGE(S) OF THE ASSOCIATED CELL FILE(S).*

	Neither extends to outer edge	One extends to outer edge	Both extend to outer edge	One or both extend to outer edge(s) (column 2 + column 3)
A. aff. *A*. *antioquiae* (coll. A)	76.7	20.0	3.3	23.3
A. aff. *A*. *antioquiae* (coll. B)	85.3	13.3	1.3	14.7
A. *cabrerae*	24.0	47.3	28.7	76.0
A. *cayapensis*	94.7	5.3	0.0	5.3
A. sp. nov. aff. *A*. *cupulifera* (coll. A)	85.3	14.7	0.0	14.7
A. sp. nov. aff. *A*. *cupulifera* (coll. B)	95.3	4.7	0.0	4.7
A. *gamotepala*	67.3	28.0	4.7	32.7
A. *hookeri*	96.7	3.3	0.0	3.3
A. *longitepala*	78.7	20.7	0.7	21.3
A. sp. nov. aff. *A*. *longitepala*	75.3	22.7	2.0	24.7
A. *moritziana*	86.0	13.3	0.7	14.0

A. aff. *A. moritziana*	73.3	25.3	1.3	26.7
A. sp. nov. aff. *A. multistaminata*	76.7	21.3	2.0	23.3
A. peruviana	37.3	32.0	30.7	62.7
A. pycnantha (n=159)	70.4	24.5	5.0	29.5
A. quinindensis	80.0	18.0	2.0	20.0
A. sp. nov. aff. *A. rhodea*	97.3	2.7	0.0	2.7
A. rigida	60.0	33.3	6.7	40.0
A. tetragona	86.0	12.7	1.3	14.0
A. urophylla	66.7	29.3	4.0	33.3
A. aff. A. *vaupesiana* (coll. A)	68.7	26.7	4.7	31.3
A. aff. *A. vaupesiana* (coll. B)	79.3	20.0	0.7	20.7
A. (Asplundia) sp. nov.	89.3	8.0	2.7	10.7
Ca. palmata (n=107)	12.1	50.5	37.4	87.9
Cy. bipartitus (n=130)	53.8	38.5	7.7	46.2
D. crinitum (n=133)	90.2	9.0	0.8	9.8
D. dolichostemon	96.7	3.3	0.0	3.3
D. globosum	89.3	10.0	0.7	10.7
D. grandifolium	99.3	0.7	0.0	0.7

TABLE 4 *(continued)*

PERCENTAGES OF STOMATAL COMPLEXES IN THE ABAXIAL EPIDERMIS IN WHICH NEITHER, ONE, OR BOTH NONPOLAR SUBSIDIARY CELL(S) EXTEND(S) TO THE OUTER EDGE(S) OF THE ASSOCIATED CELL FILE(S).*

	Neither extends to outer edge	One extends to outer edge	Both extend to outer edge	One or both extend to outer edge(s) (column 2 + column 3)
D. harlingii	100	0	0	0
D. macrophyllum	95.3	4.7	0.0	4.7
D. mirabile	96.7	3.3	0.0	3.3
D. sp. nov. aff. *D. nanum*	91.3	8.7	0.0	8.7
D. rheithrophilum	90.0	9.3	0.7	10.0
D. schultesii	93.3	6.7	0.0	6.7
D. wallisii	99.3	0.7	0.0	0.7
D. sp. nov. (coll. A)	100.0	0.0	0.0	0.0
D. sp. nov. (coll. B)	92.0	8.0	0.0	8.0
E. funifer (n=122)	45.1	39.3	15.6	54.9
L. bierhorstii	92.0	7.3	0.7	8.0
L. integrifolia	18.0	49.3	32.7	82.0
L. lancifolia (n=134)	28.4	43.3	28.4	71.7
Sch. chorianthum	96.0	4.0	0.0	4.0

Sph. acutitepala	2.0	26.0	72.0	98.0
Sph. crocea	1.3	31.3	67.3	98.7
Sph. killipii (n=151)	15.2	48.3	36.4	84.7
Sph. snidernii (n=151)	39.1	46.4	14.6	60.9
Sph. woodsonii	47.3	40.0	12.7	52.7
Sph. sp. nov. aff. *Sph. woodsonii*	24.7	47.3	28.0	75.3
Sph. sp. nov.	53.3	40.0	6.7	46.7
St. anomala	8.0	37.3	54.7	92.0
St. stylaris (n=131)	11.5	47.3	41.2	88.5
T. bissectus (n=129)	25.6	45.0	29.5	74.5

*For each species, one-hundred and fifty stomata were examined in an epidermal peel, except where another number is indicated in parentheses after the species name. As often as possible in a peel, fields were studied which were laterally rather than vertically adjacent to one another, to maximize randomness of sampling. Observations of *Cy. bipartitus* were subject to error because longitudinal files of ordinary epidermal cells tend to be difficult to identify in this species.

TABLE 5

PERCENTAGES OF SPECIES IN WHICH LOW, MODERATE, OR HIGH PERCENTAGES OF COMPLEXES EXHIBIT ONE OR TWO NONPOLAR SUBSIDIARY CELL(S) WHICH EXTEND TO THE OUTER EDGE(S) OF THE ASSOCIATED CELL FILE(S)*

	Percentage of species with low percentages of such complexes (1–11%)	Percentage of species with moderate percentages of such complexes (12 44%)	Percentage of species with high percentages of such complexes (45 99%)
Asplundia (23, 94)	21.7%	69.6%	8.7%
Carludovica (1, 3)	–	–	100%
Cyclanthus (1, 1)	–		100%
Dicranopygium (13, 48)	100%	–	–
Evodianthus (1, 1)	–	–	100%
Ludovia (3, 3)	33.3%	–	66.6%
Schultesiophytum (1, 1)	100%	–	–
Sphaeradenia (7, 42)	–	–	100%
Stelestylis (2, 4)	–	–	100%
Thoracocarpus (1, 1)	–	–	100%

*In parentheses after the name of each genus are indicated the number of species considered, and the total number of species known, not including undescribed species collected by the writer.

TABLE 6

CONTACTS BETWEEN STOMATAL COMPLEXES

	Percentage of stomatal complexes in contact with one or more other stomatal complexes	Percentage of stomatal complexes which share subsidiary cells	Percentage of contacts which entail sharing of subsidiary cells (column 2/column 1)	Types of sharing of subsidiary cells by two adjacent stomatal complexes*
Asplundia pycnantha	50.3% (n=150 complexes)	2% (n=200 complexes)	4.0%	Type 1: 100% (n=2 pairs of complexes)
Carludovica palmata	64.2% (n=151)	–	–	–
Cyclanthus bipartitus	97.0% (n=131)	11% (n=200)	11.3%	Type 1: 54.5% Type 2: 27.3% Type 3: 18.2% (n=11)
Dicranopygium crinitum	49.1% (n=159)	2% (n=200)	4.1%	Type 1: 100% (n=2)
Evodianthus funifer	47.7% (n=155)	0% (n=200)	0%	0%
Ludovia lancifolia	4% (n=200)	0% (n=200)	0%	0%
Schultesiophytum chorianthum	66.9% (n=154)	2% (n=200)	3.0%	Type 1: 50% Type 2: 50% (n=2)
Sphaeradenia killipii	65.4% (n=153)	7% (n=200)	10.7%	Type 1: 100% (n=7)
Stelestylis stylaris	70.9% (n=182)	7% (n=200)	9.9%	Type 1: 85.7% (n=7) Type 3: 14.3%
Thoracocarpus bissectus	78.3% (n=143)	6% (n=200)	7.7%	Type 1: 33.3% Type 3: 66.6% (n=6)

*Types of sharing are defined by Wilder (in press *a*).

INTRODUCTION TO TABLES 7, 9–11
(Wilder, in press *b*)*

Within interridge areas and between boundary layers, portions of cyclanthaceous laminae exhibit either two (adaxial and abaxial) or three main regions of mesophyll (adaxial, middle, and abaxial; Table 7). The adaxial region is only sometimes a palisade region, whereas, the middle and abaxial regions are spongy mesophyll. Regions of mesophyll are distinguished mostly according to features of ordinary parenchyma cells. These cells may exhibit various ergastic materials, including starch, tannin, and different kinds of crystals. In certain species some cells also contain star figures, i.e., small or large stellate inclusions tentatively interpreted as tannin. In most species ordinary parenchyma cells are essentially monomorphic, but in two species of *Dicranopygium* these cells exhibit pronounced dimorphism (Table 8). Fibers occur in the mesophyll of all species studied, but differ quantitatively between various species (Tables 9–11). Parenchyma-like dead cells were observed in several and all species of the Asplundia group and Sphaeradenia group, respectively, but only such cells of the Sphaeradenia group exhibited conspicuously birefringent cell walls. Those dead cells with birefringent walls, therefore, constitute an extremely important systematic-anatomical character within the Cyclanthaceae.

*Table no. 8 is included in Wilder (in press *b*), where it is listed as Table 1.

TABLE 7

SPECIES WITH THREE MAIN REGIONS OF MESOPHYLL (ALL UNLISTED SPECIES HAVE TWO REGIONS).

A. cabrerae
A. cayapensis
A. gamotepala
A. moritziana
A. aff. *A. moritziana*
A. pycnantha
A. sp. nov. aff. *A. rhodea*
A. tetragona
A. aff. *A. vaupesiana* (coll. *A*)
Cy. bipartitus
E. funifer
L. lancifolia
Sph. snidernii
Sph. sp. nov. aff. *Sph. woodsonii*
St. stylaris
T. bissectus

TABLE 9

DATA PERTAINING TO FIBER STRANDS OF THE MESOPHYLL

Species	No. of fiber strands/mm width of interridge area (in parentheses are indicated no. of strands counted and width of portion(s) of lamina considered in mm, respectively)	Percentage of fiber strands on adaxial half of interridge area (in parentheses are indicated no. of strands counted on adaxial and both sides of lamina, respectively
A. aff. *A. antioquiae* (coll. *A*)	29 (189, 6.64)	55.0 (104, 189)
A. aff. *A. antioquiae* (coll. *B*)	28 (203, 7.24)	64.5 (131, 203)
A. cabrerae	83 (224, 2.72)	60.3 (135, 224)
A. cayapensis	49 (119, 2.45)	59.7 (71, 119)

TABLE 9 *(continued)*

DATA PERTAINING TO FIBER STRANDS OF THE MESOPHYLL

Species	No. of fiber strands/mm width of interridge area (in parentheses are indicated no. of strands counted and width of portion(s) of lamina considered in mm, respectively)	Percentage of fiber strands on adaxial half of interridge area (in parentheses are indicated no. of strands counted on adaxial and both sides of lamina, respectively
A. sp. nov. aff. *A. cupulifera* (coll. *A*)	39 (311, 8.01)	54.0 (168, 311)
A. sp. nov. aff. *A. cupulifera* (coll. *B*)	78 (510, 6.54)	55.5 (283, 510)
A. gamotepala	93 (210, 2.26)	56.7 (119, 210)
A. hookeri	17 (94, 5.58)	48.9 (46, 94)
A. longitepala	18 (78, 4.44)	69.2 (54, 78)
A. sp. nov. aff. *A. longitepala*	48 (224, 4.70)	55.8 (125, 224)
A. moritziana	26 (196, 7.45)	52.0 (102, 196)
A. aff. *A. moritziana*	20 (119, 5.93)	58.0 (69, 119)
A. sp. nov. aff. *A. multistaminata*	24 (91, 3.83)	58.2 (53, 91)
A. peruviana	46 (205, 4.41)	61.5 (126, 205)
A. pycnantha	65 (327, 5.06)	55.0 (180, 327)
A. quinindensis	49 (232, 4.73)	56.5 (131, 232)
A. sp. nov. aff. *A. rhodea*	32 (99, 3.06)	57.6 (57, 99)
A. rigida	28 (172, 6.13)	57.6 (99, 172)
A. tetragona	38 (158, 4.19)	51.9 (82, 158)
A. urophylla	19 (121, 6.55)	61.2 (74, 121)
A. aff. *A. vaupesiana* (coll. *A*)	92 (366, 4.00)	63.7 (233, 366)
A. aff. *A. vaupesiana* (coll. *B*)	24 (127, 5.23)	70.1 (89, 127)
A. (Asplundia) sp. nov.	28 (127, 4.61)	59.2 (109, 184)
Ca. palmata	66 (480, 7.26)	61.7 (296, 480)
Cy. bipartitus	5.8 (46, 8.00)	97.8 (45, 46)
D. crinitum	40 (176, 4.41)	55.1 (97, 176)

TABLE 9 *(continued)*

DATA PERTAINING TO FIBER STRANDS OF THE MESOPHYLL

Species	No. of fiber strands/mm width of interridge area (in parentheses are indicated no. of strands counted and width of portion(s) of lamina considered in mm, respectively)	Percentage of fiber strands on adaxial half of interridge area (in parentheses are indicated no. of strands counted on adaxial and both sides of lamina, respectively
D. dolichostemon	13 (48, 3.63)	58.3 (28, 48)
D. globosum	13 (93, 7.27)	46.2 (43, 93)
D. grandifolium	12 (55, 4.66)	58.2 (32, 55)
D. harlingii	4.3 (23, 5.31)	100 (36, 36)
D. macrophyllum	27 (111, 4.12)	36.0 (40, 111)
D. mirabile	5.7 (31, 5.46)	71.0 (22, 31)
D. sp. nov. aff. *D. nanum*	9.5 (89, 9.05)	96.6 (86, 89)
D. rheithrophilum	24 (153, 6.37)	56.2 (86, 153)
D. schultesii	20 (99, 4.91)	59.6 (59, 99)
D. wallisii	19 (139, 7.49)	64.7 (90, 139)
D. sp. nov. (coll. *A*)	8.0 (79, 9.83)	50.6 (40, 79)
D. sp. nov. (coll. B)	17 (132, 7.59)	44.7 (59, 132)
E. funifer	46 (154, 3.39)	56.1 (83, 148)
L. bierhorstii	13 (67, 5.25)	82.1 (55, 67)
L. integrifolia	29 (101, 3.47)	53.5 (54, 101)
L. lancifolia	75 (482, 6.41)	57.1 (275, 482)
Sch. chorianthum	24 (110, 4.62)	64.9 (72, 111)
Sph. acutitepala	56 (333, 5.91)	50.5 (168, 333)
Sph. crocea	27 (276, 10.2)	56.5 (156, 276)
Sph. killipii	73 (456, 6.25)	50.2 (229, 456)
Sph. snidernii	30 (171, 5.65)	53.8 (92, 171)
Sph. woodsonii	108 (209, 1.93)	58.9 (123, 209)
Sph. sp. nov. aff. *Sph. woodsonii*	49 (308, 6.26)	66.2 (204, 308)
Sph. sp. nov.	30 (188, 6.27)	41.0 (77, 188)
St. anomala	41 (185, 4.48)	60.0 (111, 185)
St. stylaris	38 (397, 10.4)	56.2 (223, 397)
T. bissectus	86 (684, 7.95)	56.5 (375, 664)

TABLE 10

CONCENTRATION OF FIBER STRANDS IN INTERRIDGE AREAS*

Genus	Percentage of species with low concentration (0–19.9/mm width)	Percentage of species with moderate concentration 20–49.9/mm width)	Percentage of species with high concentration (50–109.9/mm width)
Asplundia (23, 94)	13.0%	65.2%	21.7%
Carludovica (1, 3)			100%
Cyclanthus (1, 1)	100%		
Dicranopygium (13, 48)	69.2%	30.8%	
Evodianthus (1, 1)		100%	
Ludovia (3, 3)	33.3%	33.3%	33.3%
Schultesiophytum (1, 1)		100%	
Sphaeradenia (7, 42)		57.1%	42.9%
Stelestylis (2, 4)		100%	
Thoracocarpus (1, 1)			100%

*In parentheses after the name of each genus are indicated the number of species considered and the total number of species per genus, respectively (not including undescribed species presently studied).

TABLE 11

DATA PERTAINING TO FIBER STRANDS OF THE MESOPHYLL

	Percentage of fiber strands on both sides of lamina which are in sub-epidermal layers*	Percentage of adaxially situated fiber strands in adaxial subepidermal layer*	Percentage of abaxially situated fiber strands in abaxial subepidermal layer*	Mean numbers of hypo-dermal parenchyma cells intervening between adjacent pairs of fiber strands in adaxial subepidermal layer**
A. pycnantha	43.4 (334)	46.8 (190)	38.9 (144)	2.38 (50)
Ca. palmata	43.8 (482)	53.8 (296)	28.0 (186)	1.70 (50)
Cy. bipartitus	53.1 (49)	54.2 (48)	0 (1)	10.4 (23)
D. crinitum	31.9 (329)	34.2 (184)	29.0 (145)	4.72 (50)
E. funifer	79.9 (289)	82.7 (173)	75.9 (116)	1.46 (50)
L. lancifolia	48.5 (482)	48.4 (275)	48.8 (207)	1.40 (50)
Sch. chorianthum	75.4 (187)	68.3 (123)	89.1 (64)	3.68 (40)
Sph. killipii	83.1 (455)	79.9 (229)	86.3 (226)	1.06 (50)
St. stylaris	86.4 (397)	88.3 (223)	83.9 (174)	1.06 (50)
T. bissectus	29.1 (663)	38.0 (371)	17.8 (292)	2.14 (50)

*In parentheses are indicated number of fiber strands observed.
**In parentheses are indicated number of fiber strand pairs observed.

INTRODUCTION TO TABLES 12 13
(Wilder, in press *c*)

Within interridge areas and between boundary layers cyclanthaceous laminae exhibit raphide sacs and, sometimes, also styloid sacs and/or sacs intermediate between raphide and styloid sacs (Tables 12, 13). These crystal sacs normally lack chloroplasts, but at least sometimes contain leucoplasts and, apparently, normal nuclei. In raphide sacs the raphides usually comprise an orderly array, and are sometimes compound. Styloid sacs occur in *Evodianthus funifer* and all species studied of *Sphaeradenia* and *Stelestylis*, but are less common among remaining species of Carludovicoideae. In almost all species raphide and styloid sacs tend to be oriented along paradermal planes; however, in *E. funifer* the styloid sacs normally lie in all directions within the mesophyll. Scattered regions of periderm occur in various species, apparently, because of wounding. I have developed a concept of boundary layers. A boundary layer separates ordinary mesophyll tissue from another part of the plant. Cyclanthaceous laminae exhibit four types of boundary layers, viz., hypodermis, bundle sheath, epithelium of mucilage cavities, and laticifer sheath. All boundary layers exhibit significant features in common, in addition to position, including aspects of intercellular spaces between their constituent cells, and chloroplast position. In the adaxial hypodermis the shapes of hypodermal parenchyma cells in surface view are very predictable.

TABLE 12

KINDS OF CRYSTAL SACS PRESENT WITHIN INTERRIDGE AREAS OF CYCLANTHACEOUS LAMINAE.

Species	Raphide sacs not of boundary layers	Styloid sacs not of boundary layers	Subepidermal raphide sacs	Subepidermal styloid sacs
A. aff. *A. antioquiae* (coll. *A*)	+			
A. aff *A. antioquiae* (coll. *B*)	+		+	
A. cabrerae	+			
A. cayapensis	+(I)	+(I)		
A. sp. nov. aff. *A. cupulifera* (coll. *A*)	+(S)		+	
A. sp. nov. aff. *A. cupulifera* (coll. *B*)	+		+	
A. gamotepala	+			
A. hookeri	+(I)	+(I)	+	
A. longitepala	+			
A. sp. nov. aff. *A. longitepala*	+			
A. moritziana	+			
A. aff. *A. moritziana*	+		+	
A. sp. nov. aff. *A. multistaminata*	+			
A. peruviana	+		+	
A. pycnantha	+(S)		+	
A. quinindensis	+			
A. sp. nov. aff. *A. rhodea*	+		+	
A. rigida	+		+	
A. tetragona	+		+	
A. urophylla	+			
A. aff. *A. vaupesiana* (coll. *A*)	+		+	
A. aff. *A. vaupesiana* (coll. *B*)	+		+	
A. (Asplundia) sp. nov.	+			
Ca. palmata	+(I)	+(I)	+	+
Cy. bipartitus	+	+(Bu)	+	

TABLE 12 *(Continued)*

KINDS OF CRYSTAL SACS PRESENT WITHIN INTERRIDGE AREAS OF CYCLANTHACEOUS LAMINAE.

Species	Raphide sacs not of boundary layers	Styloid sacs not of boundary layers	Subepidermal raphide sacs	Subepidermal styloid sacs
D. crinitum	+		+	
D. dolichostemon	+(I)	+(I)	+	
D. globosum	+		+	
D. grandifolium	+			
D. harlingii	+		+	
D. macrophyllum	+		+	
D. mirabile	+			
D. sp. nov. aff. *D. nanum*	+(S)		+	
D. rheithrophilum	+		+	
D. schultesii	+			
D. wallisii	+			
D. sp. nov. (coll. *A*)	+			
D. sp. nov. (coll. *B*)	+		+	
E. funifer	+	+		+
L. bierhorstii	+		+	
L. integrifolia	+		+	
L. lancifolia	+		+	
Sch. chorianthum	+			
Sph. acutitepala	+	+		+
Sph. crocea	+	+		+
Sph. killipii	+	+	+	
Sph. snidernii	+	+		
Sph. woodsonii	+	+		+
Sph. sp. nov. aff. *Sph. woodsonii*	+	+		
Sph. sp. nov.	+	+	+	
St. anomala	+	+		+

TABLE 12 *(Continued)*

KINDS OF CRYSTAL SACS PRESENT WITHIN INTERRIDGE AREAS OF CYCLANTHACEOUS LAMINAE.

Species	Raphide sacs not of boundary layers	Styloid sacs not of boundary layers	Subepidermal raphide sacs	Subepidermal styloid sacs
St. stylaris	+	+		+
T. bissectus	+			

+ = present and well-defined.

+(I) = typical raphide sacs, styloid sacs, and all intermediates between these two cell types are present.

+(S) = some sacs have small numbers of crystals which mostly tend to be intermediate between raphides and styloids, but well-defined styloids are generally absent.

(Bu) = styloid sacs are mainly limited to bundle sheaths, where they occur together with raphide sacs and intermediate types of sacs.

TABLE 13

LENGTHS OF RAPHIDE BUNDLES AND STYLOIDS IN CLEARED LAMINAE (μm, MEASURED USING CROSSED POLARS)

	Raphide bundles of abaxial subepidermal layer*				Raphide bundles of adaxial subepidermal layer*				Raphide bundles of portions of mesophyll not belonging to boundary layers**				Styloids of portions of mesophyll not belonging to boundary layers**			
	Range	Mean	Standard Deviation	Sample	Range	Mean	Standard Deviation	Sample	Range	Mean	Standard Deviation	Sample	Range	Mean	Standard Deviation	Sample
Asplundia tetragona	23–50	36.7	7.11	25	23 48	35.4	4.95	25	52 407	229	94.0	20				
Dicranopygium dolichostemon	31–115	62.2	22	25	46–145	83.5	31.5	7	46 229	141	45.8	25	172 330	223	37.1	25
Dicranopygium harlingii	29 88	47.1	11.0	25	44 88	63.9	11.7	25	80 199	129	30.0	25				
Dicranopygium sp. nov. (coll. *B*)	31–84	52.4	13.4	25	42 86	65.2	10.0	25	94 153	118	15.8	25				
Ludovia bierhorstii	23 55	37.4	8.27	25	21 48	30.6	5.88	25	29 273	169	85.2	25				
Sphaeradenia sp. nov.	15–40	26.8	4.87	25	27–65	41.2	7.32	25	74 107	86.7	7.75	25	57 191	148	33.6	25

*In *D.* sp. nov. bundles of the adaxial and abaxial hypodermides are commonly oriented anticlinally or nearly so; only bundles with essentially paradermal orientations were measured.

**In *D. dolichostemon* with all intermediates between raphides and styloids, crystals were measured only if they were clearly raphides (very narrow crystals, generally many per bundle) or styloids (broad crystals, one to several per crystal sac). In *Sph.* sp. nov. some raphide bundles in the cell layer immediately beneath the adaxial hypodermis were oriented anticlinally or nearly so, and were not measured.

INTRODUCTION TO TABLES 14 16
(Wilder, in press *d*)

Interridge areas of cyclanthaceous laminae exhibit longitudinal veins and commissural veins which vary from transverse to oblique. In at least some species of the Asplundia group, but not all of the Sphaeradenia group, these longitudinal veins tend to be oriented nearest the abaxial surface of the lamina (Table 14). In many species longitudinal veins of interridge areas are of discrete orders, and up to a given order the number of veins of an order is twice, or nearly twice that of the next lower order (Table 15). Whereas, longitudinal veins of interridge areas are normally upright, commissures vary from upright to inverted. In ten species cleared portions of lamina each measuring 120 mm^2 exhibited from six to forty-seven commissures (Table 16). Expansion tissue and presumed expansion tissue develop in all species of Carludovicoideae and in *Cyclanthus bipartitus*, respectively. Adaxial and abaxial ridges are mostly associated with one or more longitudinal veins. The main vein of a ridge is normally upright, whereas, additional vein(s) may be upright or inverted to various degrees. In interridge areas and ridges longitudinal veins are normally collateral, but bicollateral, amphivasal, and amphicribal veins may also be present.

TABLE 14

POSITIONS OF LONGITUDINAL VEINS IN INTERRIDGE AREAS (CARLUDOVICOIDEAE) OR NONCOSTAL PORTIONS OF LAMINA (CYCLANTHOIDEAE) RELATIVE TO THE ADAXIAL AND ABAXIAL SURFACES OF THE LAMINA.*

	Percentage of veins situated nearest the abaxial surface	Percentage of veins situated ca. equidistant between the two surfaces	Percentage of veins situated nearest the adaxial surface
CYCLANTHOIDEAE			
Cyclanthus bipartitus (20)	100		
CARLUDOVICOIDEAE			
ASPLUNDIA GROUP			
A. pycnantha (20)	100		
Ca. palmata (20)	100	–	–
D. crinitum (20)	100	–	–
E. funifer (20)	95	5	–
Sch. chorianthum (18)	100		–
T. bissectus (20)	100	–	–
SPHAERADENIA GROUP			
L. lancifolia (16)	31	31	38
Sph. killipii (18)	39	–	61
St. stylaris (20)	80	5	15

TABLE 15

MEAN PERCENTAGES OF THE EXPECTED NUMBERS OF LONGITUDINAL VEINS OF EACH ORDER PRESENT IN THE INTERRIDGE AREAS OF TWENTY-TWO SPECIES OF *ASPLUNDIA*, TEN OF *DICRANOPYGIUM*, AND FOUR OF *SPHAERADENIA*, AND STANDARD DEVIATIONS.* **

	First Order	Second Order	Third Order	Fourth Order	Fifth Order	Sixth Order	Seventh and Higher Orders
Asplundia (29)	100, 0	100, 0	98.9, 5.33	71.9, 33.4	15.3, 21.6	0.43, 1.46	0, 0
Dicranopygium (15.5)	100, 0	98.3, 5.28	90, 19.2	48.3, 37.9	5.63, 9.41	0, 0	0, 0
Sphaeradenia (4)	100, 0	100, 0	100, 0	68.8, 33.1	35.9, 35.5	1.56, 1.80	0,0

*The mean percentages for each genus were computed as follows. For every species the percentage of the expected number of veins present of each order was determined, based on a sample of one to several interridge areas. Then, the percentages for each order of vein were averaged for all species (the species being weighted equally, regardless of the number of interridge areas counted per species).

**In parentheses after the name of each genus is indicated the number of interridge areas examined of all species.

TABLE 16

NUMBERS OF COMMISSURES WITHIN 120 mm^2 OF LAMINA, AWAY FROM COSTAE*

SPECIES	NUMBER OF COMMISSURES
A. pycnantha	10
Ca. palmata	31
Cy. bipartitus	31
D. crinitum	47
E. funifer	12
L. lancifolia	10
Sch. chorianthum	45
Sph. killipii	10
St. stylaris	14–15
T. bissectus	6

*Branches of commissures were counted as separate commissures. For example, in a case where a commissure became divided into two parts at one end, the undivided portion and its two products were interpreted to represent a total of two commissures.

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THE INDIGENOUS PALM FLORA OF "LAS GAVIOTAS," COLOMBIA, INCLUDING OBSERVATIONS ON LOCAL NAMES AND USES

MICHAEL J. BALICK

This flora describes the palms found in the gallery forests of "Las Gaviotas," Colombia, located in the Comisaria del Vichada. The region is of interest for three major reasons. Firstly, its plants are typical of the Orinoco drainage area of the Colombian Llanos, which serves as a bridge between the Amazonian and Orinoco floras. Secondly, the actual site of "Las Gaviotas" is an experimental center for, among other things, developing technologies for colonization of the Llanos. Lastly, the palms play an important role in the everyday lives of the Guahibo Indians inhabiting this territory. This ethnobotanical usage has been discussed in detail in another paper (Balick, 1980a).

A number of other palm species are found in gallery forests and open savannas of the vast Llanos region of Colombia and Venezuela. The present work is, therefore, intended as a basis for comparative studies, as well as a foundation upon which further botanical studies may be carried out.

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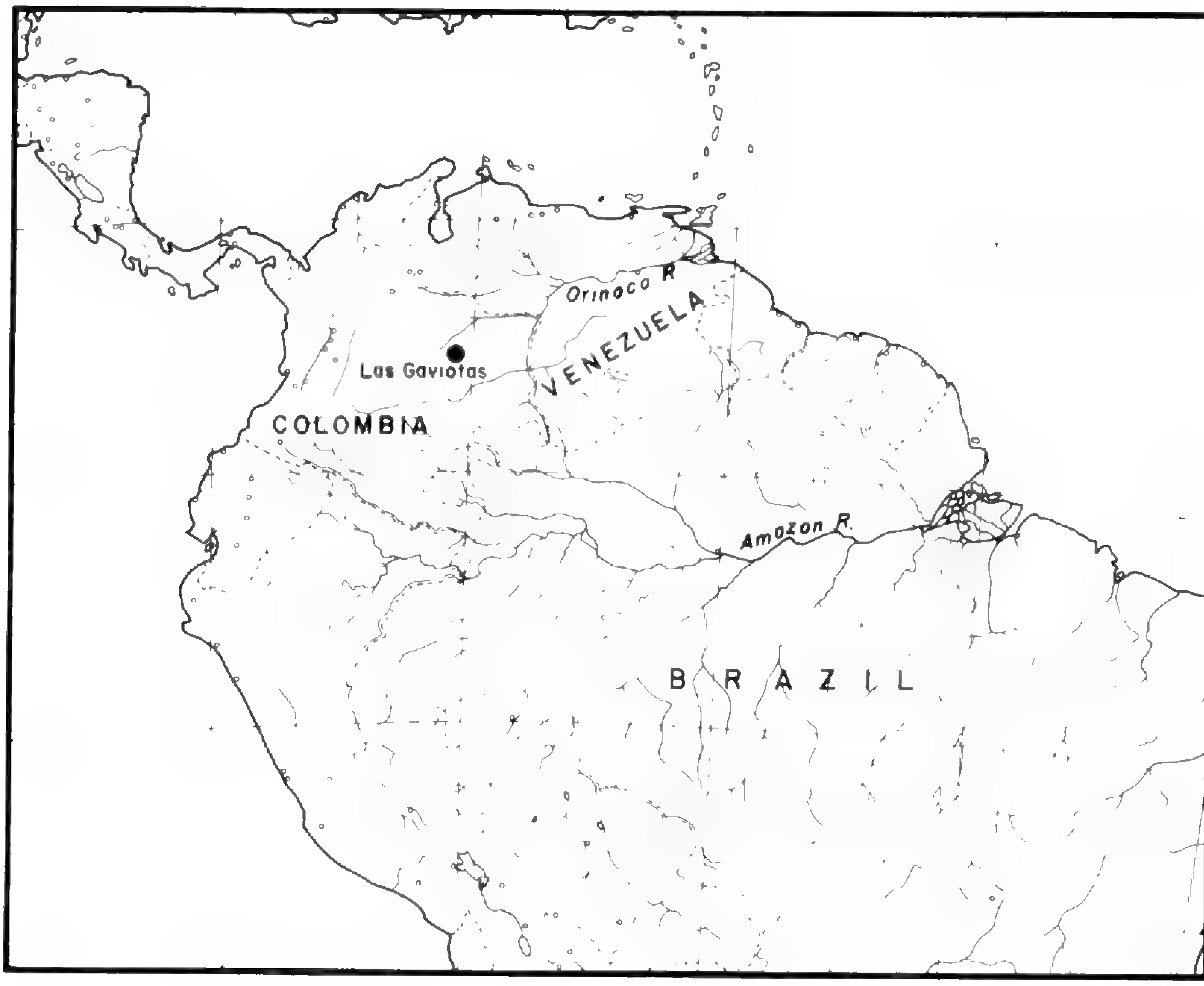

Fig. 1. Location of "Las Gaviotas."

The Centro de Desarrollo Integrado "Las Gaviotas" contains 2,491 hectares of land, embracing the characteristic savanna and gallery forest biota. The savanna is primarily composed of grasses, interspersed with a few islands of low-growing trees. This geobotanical formation, called "Llanos" in Spanish, covers over 480,000 square kilometers in both Colombia and Venezuela (Blydenstein, 1967). Gallery forests that border the rivers and streams traversing the savanna range from dense to fairly open stands of shrubs, lianas, and taller trees. The settlement is between 4° and 5° latitude north and 70° and 71° longitude west, at an altitude of 167 meters above sea level. Rainfall averages 2,700 mm, annually, unevenly distributed and concentrated between June and August. The average annual temperature is 27°C with a maximum of 32°C recorded in March and April and a minimum of 22°C during the rainy season, June–August. Detailed studies of the soil morphology and composition have

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The paging in this issue has been inadvertantly misnumbered, starting with page 1 instead of page 135.

Corrections for the corresponding pages will appear in the INDEX with double citations (1) 135 to (64) 198.

been recently published by Benavides et al. (1975). From the viewpoint of agriculture, the soil is poor in the savanna and somewhat richer in the gallery forest. Local agriculture is usually confined to cleared sections of gallery forest, close to running water.

Some of the most striking elements of the "Las Gaviotas" gallery forest are its palms, which in many areas are the major elements of vegetation. In growth form they range from vines (*Desmoncus*) to small or medium-sized understorey components (*Geonoma, Syagrus, Astrocaryum*) and large-trunked trees (*Mauritia, Jessenia*). Furthermore, in certain moist areas are found pure stands of *Jessenia bataua* and *Mauritia flexuosa*. Recent work by de Granville (1974) in French Guiana has shown that it is the specialized root structure of certain palms, specifically the occurence of pneumatodes, that enables them to survive and flourish under conditions of seasonal or permanent inundation.

The taxonomic identity of palms is often problematical, especially of those found in remote areas. Their great bulk and often spiny nature discourage the botanist from collecting and studying these organisms, unless he or she is specifically prepared for this task and willing to forego general collecting. Thus, type and other comparative herbarium material is often quite poor and limited in nature, making proper identification difficult. In the "Las Gaviotas" region there are several palm species of uncertain taxonomic affinities, particularly in the genera *Astrocaryum, Bactris,* and *Desmoncus*. I have taken a conservative taxonomic position on these, feeling that specific determinations must wait until complete monographic treatments are undertaken of these genera throughout their entire range.

The indigenous palms inhabiting the gallery forests of "Las Gaviotas" can be distinguished through the use of the following key.

KEY TO THE INDIGENOUS PALM FLORA OF "LAS GAVIOTAS", ORINOQUIA, COLOMBIA

1. Leaves palmate; inflorescence producing scaly fruits .... 1. *Mauritia flexuosa*

1. Leaves pinnate or entire; inflorescence with fruits lacking scales.
   2. Liana; pinnae in the upper portion of the leaf modified into retrorse spines; leaf sheaths spiny. .... 2. *Desmoncus* sp.
   2. Erect trees or shrubs; pinnae in the upper portion of the leaf not modified into spines; leaf sheaths spiny or smooth.
      3. Trunk and leaf sheaths spiny at maturity, or if plant acaulescent, petiole and rachis covered with spines.
         4. Trunk diameter 1–2.5 cm; lower surface of pinnae green.... .... 3. *Bactris* aff. *maraja*
         4. Trunk diameter 4–5 cm or lacking entirely; lower surface of pinnae silver or scurfy-whitish.
            5. Leaves to 2.25 m long, with pinnae regularly arranged along the rachis; trunk developed .... 4. *Astrocaryum* aff. *munbaca*
            5. Leaves to 5 m long, with pinnae irregularly arranged along the rachis in separated groups of 2–3(4); trunk not developed .... 5. *Astrocaryum acaule*
      3. Trunk and leaf sheaths smooth at maturity.
         6. Stilt roots present, these containing spines. .... 6. *Socratea exorrhiza*
         6. Stilt roots absent, trunk firmly inserted into the ground.
            7. Inflorescence a hippuriform panicle, shaped like horse's tail.
               8. Underside of pinnae covered with sickle-shaped trichomes .... 7. *Jessenia bataua*
               8. Underside of leaves without trichomes, often with a waxy bloom that wears away with age.
                  9. Trunk solitary; leaves ca 4.25 m long, pinnae 80–90 per side; rachis 0.7–1.0 m long .... 8. *Oenocarpus bacaba*
                  9. Trunks solitary to few and clustered; leaves ca 2.25 m long, pinnae 55–60 per side; rachis 0.4–0.5 m long .... 9. *Oenocarpus mapora*
            7. Inflorescence not a hippuriform panicle.
               10. Pinnae clustered.
                   11. Inflorescences differentiated into two kinds on the same plants, one androgynous with pistillate and staminate flowers at the base of the rachis but only pistillate distally, and the other entirely staminate; trunk greater than 15 cm in diameter .... 10. *Maximiliana maripa*
                   11. Inflorescences of one kind on any plant, each containing staminate and pistillate flowers; trunk no greater than 10 cm in diameter.......... .... 11. *Syagrus inajai*
               10. Pinnae regularly arranged or undivided laterally.
                   12. Tall palm with many regularly inserted, pendulous, one-ribbed pinnae .... 12. *Euterpe precatoria*

12. Undergrowth palm with pinnae few, often several-ribbed and spreading .... 13. *Geonoma deversa*

DESCRIPTIONS

Descriptions have been compiled from field observations and collections, in combination with the following references where needed, to achieve further clarity and a greater understanding of the variation possible in a particular species: Balick (1980b), Dugand (1976), Glassman (1970), Macbride (1960), Wessels Boer (1965, 1968, 1972).

1. **Mauritia flexuosa** L.f. Suppl. Pl. 454, 1782.

Tall, solitary, dioecious palms to more than 25 m; trunk 30–40 cm in diameter, with leaf scars apparent. Leaves costapalmate, to 4 m or longer from sheath to tip; segments many, 1–2 m long; dead leaves persisting but finally falling from the coma with time. Panicles several per tree; peduncle 0.6–1 m long; second order branches 30 or more, each to 1 m long; flowers in short, bracteate spikes. Fruits ellipsoid, subglobose, ca 5 × 3–4 cm, covered with scales and turning orange-red when ripe, each fruit weighing ca 26 grams; mesocarp pulpy, bright orange in color; endocarp stony; endosperm white, homogenous, solid.

DISTRIBUTION: Colombia, Venezuela, Trinidad, the Guayanas, Perú, Brazil, Bolivia.

Mauritia flexuosa is common in swampy, seasonally inundated or moist areas of the Llanos. It is social in habit, occuring in stands of almost uncountable numbers. The huge populations of this palm with their columnar trunks form a breathtaking sight, which Wallace (1853) described as "...a vast natural temple which does not yield in grandeur and sublimity to those of Palmyra or Athens."

The Llaneros believe that the abundance of these palms in wet areas is due to the ability of the leaves to attract the water vapor from the air and "concentrate" it at the base of the tree, as Humboldt (1852) mentioned, "...for this reason water is constantly found at its foot, when dug for to a certain depth."

During a trip to "Las Gaviotas," in 1978, I was unable to locate plants bearing either flowers or fruits. While *Mauritia flexuosa,* in this region at least, is thought to flower and fruit heavily only every other year, the total absence of sexual material leads me to believe that the heat from the abnormally frequent savannah fires around "Las Gaviotas" during the previous year had killed most of the developing inflorescences. Accordingly, the botanical description has been excerpted from the literature and may not exactly conform to the Llanos population.

There are probably only a few good species in this genus, excluding those formerly considered as *Mauritiella,* a genus recently put into synonomy with *Mauritia* (Balick, 1981). The true identity of this particular population is uncertain. Dugand (1940) cited it as *M. flexuosa,* and in a later posthumous edition revised by Reed (Dugand, 1976), called the Vichada population *M. minor* Burret. Dahlgren (1936) listed *M. minor* from Florencia, Caquetá, but as the Llanos population is in the Orinoco drainage, it is geographically closer to the vast stands of *M. flexuosa* found in Venezuela (Wessels Boer, 1972). In his study of the palms of Surinam, Wessels Boer (1965) treated the two species as one under the name *M. flexuosa.* The supposed differences between them are principally in structure of the fruit, which can vary a great deal even within one population. This genus, so important from an economic and ecological standpoint, is in great need of revision. Many more field observations and collections of *Mauritia* must be made throughout its wide distribution in tropical South America and Trinidad.

Common Names: "Moriche" (Spanish); "Inójo" (Guahibo).

Uses: The leaves are used for thatch and provide a fiber for weaving. The Guahibo prepare a fermented drink from the fruits. Rafts for fishing are constructed from the dried petioles. Shortly after the trunks of old trees fall, they become infested with weevil larvae which are collected and eaten.

2. **Desmoncus** sp.

Vining palm to 10 m or more; trunk ca 2.5 cm in diameter, flexible, covered with straight, dark brown spines to 2.5 cm long that are triangular in cross section and bulbous at base. Leaves distichously arranged, to 1 m long or more, pinnate; terminal pinnae modified into paired hooks with swollen bases clasping supporting vegetation; rachis with scattered, dark brown curved spines, ca 1 mm long with bulbous bases; pinnae ca 22–32 per leaf, irregularly arranged, 20–25 × 2.5–3.0 cm, with a prominent midrib. Panicle ca 30 cm long, bearing two bracts, the inner ca 35 × 5 cm, spined. Flowers and fruits unknown.

DISTRIBUTION (of *Desmoncus*): Mexico, Belize, Guatemala, Costa Rica, Panama, Colombia, Venezuela, Trinidad, the Guayanas, Brazil, Bolivia.

This vining palm is common in seasonally inundated areas of the gallery forests as well as along the banks of streams. The stems are supported by the surrounding vegetation and often difficult to separate for collection. As neither fruits nor flowers have been collected and no other material from the same location is available, a specific determination is impossible at present. The species of this genus of bactroid palms are in any case difficult to identify due to the phenotypic diversity mentioned by Wessels Boer (1965). Organs such as the leaf and bract exhibit a startling plasticity, those of one species varying greatly under different conditions of light and water, or with age. Dugand noted four species of *Desmoncus* in his 1940 treatment of the palms of Colombia: *D. horridus* Splitg. ex Mart., *D. leutzelburgii* Burret, *D. setosus* Mart., and *D. tenerrimus* (Mart. ex Drude) Mart. ex Burret. Three species were added in his 1976 revision: *D. myriacanthos* Dugand, *D. riparius* Spruce, and *D. vacivus* Bailey.

This genus of palms is certainly in desperate need of taxonomic revision. The climbing habit and extreme plasticity of the organs make *Desmoncus* a challenging candidate for a comprehensive monographic study.

COMMON NAMES: "Enredadera" (Spanish); "Camuvé" (Guahibo).

USES: Not known to be used in this area, but in other parts of the Amazon Valley it is used to make basket frames.

3. **Bactris** *aff.* **maraja** Martius, Hist. Nat. Palm. 2:93, t. 71, fig. 1. 1826.

Trunks 4 m tall, growing in groups of ca 15 together, 2–2.5 cm in diameter and covered with flattened white, black tipped spines 1–4.5 cm long. Leaves ca 5 per stem, pinnate; sheath 32 cm long; petiole 36 cm long; rachis ca 1.20 m long with 42–45 linear-oblanceolate, sigmoid, acuminate pinnae ca 28–30 × 6 cm, irregularly grouped and inserted at various angles to the plane of the leaf; spines prominent on sheath and petiole, these creamy white, flattened, with black bases and tips 10–20 × 2–3 mm, with few on rachis. Inflorescence bearing two subequal bracts, the outer one a prophyll 25 cm long, papery and lacking spines, the inner a peduncular bract, brown, 30 × 2 cm, covered with many flattened black to white spines to 5 mm long; axis ca 15 × 7 mm with ca 12 rachillae, each ca 13 cm long. Staminate flowers yellowish. Fruits dark purple when ripe, flattened-globose, 1.5 cm in diameter, with a 2 mm long stigmatic residue at the apex.

DISTRIBUTION (*B. maraja*): Colombia, Guyana, Surinam, Perú, Brazil, Bolivia.

This palm is identified only provisionally as *B. maraja,* owing to the confused taxonomy of this poorly known genus. According to Moore (pers. comm.) it appears to key out in Drude's treatment in *Flora Brasiliensis* (1882) to either *B. chloracantha* Poepp. or *B. pallidispina* Mart. Macbride's description (1960) of *B. chloracantha* notes a stem "...8 cm in diameter, more or less aculeate with straw-colored, subterete spines..." and leaf segments with setulose margins. The palm in question, as noted in the above description, has a much smaller stem diameter, both light- and dark-colored, flattened spines, and smooth leaf margins. Wessels Boer's (1965) description of *B. pallidispina* (which he reduced to synonomy under *B. maraja*) fits this palm, except again for the ciliate margins of the pinnae. Martius (1847) published a plate of *B. pallidispina* along with descriptions of that species and of *B. maraja.* From these descriptions, my material from "Las Gaviotas" agrees very closely with *B. maraja.* The type specimen, *Poeppig 2107,* appears of little value in clarifying the determination, as the photo shows it to consist of young leaves and an immature fruiting panicle. However, from the photo it can be seen that the perianth of *B. chloracantha,* which persists in fruit, is mucronate, in this apparently differing from the "Las Gaviotas" material which lacks the sharp point. I am unsure if this structure is stable or variable in the bactroid alliance.

Wallace (1853) described fruit of *B. maraja* as having "...a thin pulp of an agreeable sub-acid flavour—a pecularity not found in the fruit of any other American palm that I am acquainted with." This taste is characteristic of the palm in the Llanos. However, according to Moore (pers. comm.), a subacid flavor is probably characteristic of fruits of several species of

Bactris, such as those sold in season in the market of Iquitos, Peru.

Common Names: "Espina" (Spanish); "Xaneeboto" (Guahibo).

Uses: The fruits are edible and used to quench thirst.

4. **Astrocaryum** aff. **munbaca** Martius, Hist. Nat. Palm. 2:74. 1824.

Trunk 5 m tall, 5 cm in diameter, armed with rings of flattened black spines 4–6 cm long. Leaves pinnate; sheath ca 18 cm long; petiole ca 74 cm long; rachis ca 1.4 cm long, all with flattened spines; 19 pinnae per side, more or less oppositely arranged; apical pinnae 60 × 1.5 cm; middle pinnae 50–70 × 4 cm; basal pinnae 50 ×2.5 cm, dark green, glossy above, scurfy-whitish on underside. Panicle 60 cm long; peduncle covered with black spines to 1 mm long; peduncular bract 68 cm long by 8 cm in circumference, densely covered with dark spines 5–6 mm in length; rachis bearing more than 100 rachillae with a single pistillate flower at base of each. Pistillate flowers ca 8 mm long. Fruits obovate, long-rostrate at apex, ca 3 cm long, excluding the rostrum (1 cm long), brownish-red at maturity.

Distribution (of *A. munbaca*): Brazil, Colombia, Surinam, Venezuela.

A small population of this plant was found growing under semi-open canopy in gallery forest, on firm ground. Because of the lack of flowers or fruits, its identification cannot be certain, although it appears to be comparable with *Astrocaryum munbaca.* Schultes (1951) cited the first Colombian collection of this plant from the Río Caraparaná in the Vaupés and noted that the fruits are edible. I have been unable to locate additional material of this species from Colombia. Perhaps this collection represents a link between the flora of the Northwest Amazon and that of the Orinoco drainage in Colombia. The species is found in Venezuela, in T. F. Amazonas.

Common Names: "Cubarillo" (Spanish); "Xaneeboto" (Guahibo).

Uses: While no uses are reported for this region, the fruits are consumed in the Amazon Valley.

5. **Astrocaryum acaule** Martius, Hist. Nat. Palm. 2:78, t. 24, 63, fig. 5. 1824.

Trunkless palm, 3 m tall. Leaves pinnate; petiole ca 1 m long; rachis ca 1.75 m long, both petiole and rachis covered with scurfy brown scales and dark brown, flattened, dentate, downward-pointing spines; pinnae 146–180 per side, inserted singly or in groups of 1–4, at various angles to the plane of the leaf, apical segments of a more regular arrangement; basal pinnae 50 × 1 cm; middle pinnae 55 × 1.5–2.0 cm; apical pinnae 75 × 7.5 cm; pinnae light green above, silvery on underside; midrib edged with thin spines 2 mm long. Panicle axillary, ca 1.10 m long, bearing a peduncular bract, light brown, covered with flattened, dark brown spines ca 2 cm long; bract bending in center with age, forming a hood over the fruits; peduncle ca 75 cm long, spined, rachis 20 cm long with many rachillae ca 10 cm long. Flowers not seen. Fruits ovoid, apically beaked, 3.0–3.5 × 2.0–2.5 cm, orange when ripe.

DISTRIBUTION: Colombia, Venezuela, Brazil.

Wallace (1853) noted this palm as common in the dry catinga forests of the upper Rio Negro. In his opinion, "...it has altogether a rather repulsive and inelegant appearance." However, in the Llanos, forest vegetation of any type is most welcome, and thus I am unable to concur with his feelings about this plant. Rather the opposite in fact, the acaulescent habit and "hooded" inflorescence make *A. acaule* one of the more unusual and even beautiful species in the genus.

COMMON NAMES: "Espina" (Spanish); Mataviсúli" (Guahibo).

USES: The Gauhibo collect the ripe seeds of this species and use them to cap the silípu, or snuff tubes. After the epicarp and mesocarp are removed, the endocarp is pierced longitudinally and attached to one end of the tube to be inserted against the nostrils.

6. **Socratea exorrhiza** (Martius) Wendland, Bonplandia 8:103, 1860.

Trunk 15–20 m tall, ca 12 cm in diameter, occasionally swollen at middle, with stilt roots covered with spines 5 mm long. Leaves pinnate, ca 7 per coma, with clasping sheaths forming a crownshaft; sheath 1.2 m long; petiole 25 × 2.5 cm; rachis 1.9–2.0 m long; pinnae ca 16 per side inserted irregularly along the entire length of the rachis, dark green above, light green below, laciniate, divided into numerous wedge-shaped, dentate segments, middle pinnae ca 90 × 23 cm; apical pinnae 35 × 7 cm. Inflorescences 1–4 per stem, ripening below the crownshaft; bracts ca 7; primary axis 29 cm long by 2 cm wide at base of first bract scar, reflexed into the shape of an inverted "U" upon maturation; rachillae 10, each ca 45 cm long. Flowers not seen, (presumably) unisexual. Fruits ellipsoid, 2.75–3.0 × 2.0–2.25 cm, orange-yellow when ripe, with a small apical or slightly excentric stigmatic residue.

DISTRIBUTION: Colombia, Venezuela, Guyana, Surinam, Ecuador, Brazil, Bolivia.

This is a common palm, forming large populations in inundated areas of the gallery forests. It is somewhat unusual to find the stems swollen, a characteristic more commonly ascribed to *Iriartea ventricosa* Martius.

COMMON NAMES: "Araco:" (Spanish); "Misibóto" (Guahibo).

USES: The trunk of this species is split and used for roof crossbars, walls, and corrals. Older palms are sometimes cut to make bows.

7. **Jessenia bataua** (Martius) Burret, Notizbl. 10: 302. 1928.

Trunk solitary, 15–25 m tall, 15–25 cm in diameter, smooth, free of fibrous covering at maturity, often with a mass of slender roots at base. Leaves pinnate, sheath ca 1 m long, olive green, lined on the upper edges with a mat of brown fibers and dark brown, erect spines to 1 m long; petiole ca 1 m long, rachis 4–6 m long; pinnae ca 193–212, regularly arranged in a single plane, opposite or subequal, glossy green above, whitish-gray below, covered with small, sickle shaped to peltate scales; basal pinnae 0.6–1.5 m × 2.5–2.75 cm; middle pinnae 1.0–1.7 m × 6–11 cm; apical pinnae 15–70 × 1.5–3.5 cm. Panicle bearing 2 bracts; the outer a prophyll ca 70 cm long, the inner a peduncular bract to 2–2.25 m long by 15 cm wide at center, tapering to a slender point and opening along its entire length; hippuriform (shaped like a horse's tail), 1–4 per tree visible at any one time; primary axis variable in size often 30–40 cm long by 7.5–8.5 cm wide at the base of the bract scar; rachillae ca 169–212, to 1 m long, pendulous, creamy-white at anthesis, changing to scurfy red in fruit; flowers borne in triads of 1 inner pistillate and 2 outer staminate on the proximal 1/3–1/4 of the rachillae, distal to which are found only staminate flowers, rachillae attenuate towards apex. Staminate flowers 5–6 mm long, sepals 3, petals 3, stamens 8–16, filaments awl-shaped. Fruits ovoid, variable in size and shape, 2.4–2.9 cm long, each weighing to 12 gms or more, purple-black when ripe; endosperm ruminate.

DISTRIBUTION: Colombia, Venezuela, Guyana, Surinam, French Guiana, Ecuador, Perú, Brazil.

Jessenia bataua is one of the more important palms of the gallery forests, both from an ecological and an economic standpoint. It is found either scattered in upland sites or in almost pure stands in lower, inundated areas. Depending on the habitat, plants can vary greatly in trunk diameter and inflorescence structure (e.g., number of rachillae, diameter of peduncle, and fruit yield). Panicle dimensions and overall number depend also on the health and age of the individual tree. The stem of young palms is covered with a mat of brown, thread-like fibers and stiff brown spines, these falling off by the time of first fruiting. Afterwards the trunk is smooth and slick, impeding efforts to climb it. Thus the tree is often felled to harvest the fruits, and is in danger of extinction in some areas.

COMMON NAMES: "Seje" (Spanish); "Oxáe," "Pevítsa," "Ataíto" (Guahibo).

USES: The rich fruits are processed to yield an oil similar in appearance and taste to olive oil. A milklike beverage is produced from the ripe fruits and is an important source of protein (Balick & Gershoff, 1981). Bows and arrow points are also made from the wood of older palms.

8. **Oenocarpus bacaba** Martius, Hist. Nat. Palm. 2:24, t. 26, fig 1–2. 1823.

Trunk solitary, 9–15 (20) m tall, 11–15 cm in diameter, smooth at maturity, often with a mass of slender roots at base. Leaves pinnate; sheath 70 cm long, 35 cm in circumference, green, edged on the upper portion with small brown fibers; petiole 70 cm long by 4 cm wide at base; rachis ca 3.5 m long, covered with red-brown scales, especially evident in young leaves; pinnae 86–90 per side, inserted irregularly in groups of 1–5 and at various angles to the rachis; basal pinnae 0.7–1.2 m × 1.5–4.0 cm, middle pinnae 0.9–1.6 m × 3 7 cm, apical pinnae 30–70 × 1.5–2.25 cm, green above with whitish-waxy bloom beneath. Panicle bearing 2 bracts, the outer a prophyll 55 cm long by 20 cm wide at center, the inner a peduncular bract, 0.8–2.0 m × ca 10 cm long, tapering to a point; primary axis variable in size, ca 20 cm long, 4.5 cm wide at base of bract scar; rachillae ca 110, 0.7–1.0 m long, attenuate, creamy-white in flower, scurfy-red in fruit; flowers borne in triads of 1 inner pistillate and 2 outer staminate on the proximal 3/4 of the rachilla, distal 1/4 of rachilla bearing staminate flowers only. Staminate flowers with 3 sepals, 3 petals, and 6 stamens. Fruits subglobose, 1.75–2.5 × 1.25–2.0 cm, endosperm homogenous; epicarp dark purple when ripe.

DISTRIBUTION: Colombia, Venezuela, Guyana, Surinam, French Guiana, Perú, Brazil.

Oenocarpus bacaba is a social palm found in association with *Jessenia bataua,* but fruiting at an earlier time. This species is quite variable, and often intergrades into apparent hybrids with *O. mapora.* Panicles vary greatly in size, apparently depending on habitat and on age of the tree. Wessels Boer (1972) assigned varietal status to the small-, medium- and large-fruited forms in Venezuela, with which I cannot concur.

Common Names: "Seje pequeño" (Spanish); "Cupéri" (Guahibo).

Uses: Both oil and a milklike beverage, similar to that of *Jessenia bataua,* are produced from the ripe fruits.

9. **Oenocarpus mapora** Karsten, Linnaea 28: 274 t. 55. 1857.

Trunks solitary to caespitose, 8–14 m tall, 10 cm in diameter, when young covered with brown, strawlike fibers, becoming clean and smooth at maturity. Leaves pinnate; sheath ca 50 cm long by 22 cm in circumference, olive green; petiole 10 × 3 cm; rachis ca 2.25 m long, covered with red-brown scale; pinnae 54–69 per side, regularly or irregularly inserted along the rachis, some in groups of 2 and at an angle to the plane of the leaf; basal pinnae 55–75 × 2.0–3.5 cm, middle pinnae 0.6–1.0 m × 3.5–5.5 cm, apical pinnae 20–33 × 1.25–2.75 cm, all glossy green above, underside with a waxy bloom. Panicle bearing 2 bracts, the outer a prophyll 25–45 cm long, the inner a peduncular bract 50–85 cm long; primary axis variable in size and shape, ca 13–19 cm long by 2.75 cm wide at base of bract scar, emerging white, changing to scurfy-red in fruit; rachillae ca 75–80, ca 40–50 cm × 2–3 mm; flowers borne in triads of 1 pistillate surrounded by 2 staminate on proximal 1/5 to 1/3 of the rachilla, on distal section only staminate flowers present. Staminate flowers with sepals 3, petals 3, stamens 6. Fruits subglobose, 1.75–2.5 × 1.5–2.0 cm, purple-black when ripe; endosperm homogenous.

Distribution: Costa Rica, Panama, Colombia, Venezuela, Ecuador, Perú, Brazil, Bolivia.

This palm, which is widespread in the Amazon Valley, is either caespitose or solitary in habit. Local people claim that the palms, which are highly valued for their oily fruit, flower three years after planting. Because of its slight stature, the trunk is easily climbed and is not cut for harvesting. The variation in pinna insertion in the same population, either regular or irregular, is quite striking.

Common Names: "Seje pequeño," (Spanish); "Macopáji" (Guahibo).

Uses: A milklike beverage, similar to that derived from *Jessenia bataua,* is made from the ripe fruits, which are also occasionally used for oil production. The slender, straight stems are used for gates and in construction.

10. **Maximiliana maripa** (Corrêa da Serra) Drude, Mart. Fl. Brazil. 3: 452, t. 104. 1881.

Trunk solitary, to 10 m high or more, 30 cm in diameter, smooth with obscure leaf scars, leaf bases below crown temporarily persistent. Leaves ca 23–25 per tree, pinnate with ca 140–260 pinnae in groups of 4–9 and inserted at various angles to the rachis (excepting at the apex); sheath ca. 1 m long; petiole ca 3 m long; rachis ca 7 m long; basal pinnae ca 70–90 × 1.7–2.5 cm; middle pinnae 95–105 × 4.5–5.0 cm; apical pinnae 40–52 × 1–1.7 cm. Panicle bearing an inner bract ca 1.5 × 0.5 m, brown, outer surface ridged and disintegrating somewhat upon maturity of fruiting panicle; panicle ca 1.5 m long with many rachillae; flowers unisexual, pistillate ca 8 or more congested at the base of rachillae ca 20 cm long. Pistillate flowers ca 5 mm long; 3 sepals, 1/3 as long as the petals; 3 petals, ca 1/5–1/2 as long as the stamens; stamens 6. Fruits 5–8 cm long, ovoid-oblong with a prominent beak, half enclosed by a brown-lepidote, glabrescent cupule formed by persistent perianth; exocarp fibrous; mesocarp pulpy, yellow; endocarp hard, mostly 1-seeded but some 2–3 carpellate; endosperm white, homogenous, solid.

DISTRIBUTION: Colombia, Guyana, Trinidad, French Guiana, Perú, Brazil.

This is another palm that is social in habit, although not usually found in as pure a stand as some of the others. The most recent treatment of *Maximiliana* by Glassman (1978 a, b) combines all previously described species into one, *M. maripa.*

COMMON NAMES: "Inajá" (Spanish); "Naxáribo" (Guahibo).

USES: The endosperm of the ripe, toasted fruit is an important source of food for the Guahibo. The oil-rich mesocarp is mixed with water and consumed as a beverage. Newly emerging leaves of low growing trees are harvested and used to weave mats and pack baskets. In addition, the seeds of *M. maripa,* with the epicarp and mesocarp removed are used to cap the end of snuff tubes.

11. **Syagrus inajai** (Spruce) Beccari, L'Agric. Colon. 10: 467. 1916.

Trunk 10 m tall, 7.5 cm in diameter, smooth, often slightly irregularly swollen. Leaves ca 12 per coma, pinnate; sheath 20 cm; long; petiole 50 cm long; rachis 1.6 cm long, triangular in cross-section and scurfy-brown abaxially; pinnae 140–146, inserted singly or in groups of 2–4 per side and at various angles to the plane of the leaf; basal pinnae ca 44 –1 cm; central pinnae ca 45 × 3–3.5 cm; apical pinnae ca 26 × 1.3 cm; midveins prominent and transverse commissures evident between secondary veins. Panicle bearing two bracts, the inner one peduncular ca 1.10 m long, brown, ridged, opening along its length and persistent; primary axis ca 75 cm long, brown-scaly; rachillae 23–25, each 30 cm or longer; flowers borne in triads of two staminate and one pistillate. Staminate flowers ca 12 mm long. Fruits ca 4 × 3 cm, including cupule, oblong with a small, apical stigmatic residue, turning yellow when ripe; endosperm homogenous.

DISTRIBUTION: Colombia, French Guiana, Brazil.

In the Llanos, *Syagrus inajai* is often found in quantity along the margins of the gallery forests where it grades into the savanna, and also as an understorey palm inside the gallery forests.

COMMON NAMES: "Churúbay" (Spanish); "Oróboto" (Guahibo).

USES: The wood is used in construction of houses, for fencing corrals, and occasionally in bow making. Hunting traps and blinds are placed near these palms for capture of "Lapa" (*Agouti* sp.) and "Peccari" (*Tayassu* sp.) in search of the fruits.

12. **Euterpe precatoria** Martius, Palmet. Orbign. 10, t. 8, t. 18a, fig. 2. 1847.

Trunk solitary, to 20 m tall, 15 cm in diameter, smooth. Leaves 12–15, pinnate; sheaths forming a crownshaft ca 1.15 m long striped with green and yellow; petiole ca 25 × 3 cm, golden-yellow; rachis ca 2.6 m long; pinnae ca 88 per side; more or less oppositely arranged at regular intervals, drooping on older individuals; basal pinnae 60 × 0.5 cm; middle pinnae 90 × 1.6 cm; apical pinnae 75 × 1.5 cm. Panicle bearing 2 subequal bracts, the inner ca 90 cm long, primary axis 45 cm long by 4.5 cm wide at bract scar, rachillae white-tomentose, ca 88, 50 × 70 cm long; flowers borne in triads of 1 pistillate surrounded by 2 staminate on proximal 4/5 of the rachilla, on distal 1/5 only staminate flowers present. Staminate flowers pink at anthesis. Fruits oblique-globose, ca 1 cm in diameter, ripening dark purple, stigmatic residue subapical; endosperm homogenous.

DISTRIBUTION: Colombia, Venezuela, Trinidad, Guyana, Surinam, Perú, Brazil, Bolivia.

Euterpe precatoria is a member of a widespread Neotropical genus of about 50 species. It is social in habit, sometimes forming almost pure stands, especially in swampy areas.

COMMON NAMES: "Manáco" (Spanish); "Manacáy" (Guahibo).

USES: The leaves are used for thatch and the trunk for corrals. The palmito is edible and delicious.

13. **Geonoma deversa** (Poiteau) Kunth, Enum. Pl., 3: 231. 1841.

Trunk 1–2 m tall, 1.25 cm in diameter, prominently ringed; internodes 1–2.5 cm long. Leaves ca 8 per stem; sheath 6–7 cm long and fibrous marginally; petiole 7–10 cm long; rachis 30 cm long; blade divided into 3 or more opposite pairs of segments, dark green above, light green below, each ca 25 cm long and of variable width. Inflorescence in bud bearing two light brown, scale-covered bracts; panicle 20–30 cm long with 5–8 rachillae, green in flower turning red upon fruiting; flowers borne in triads of two staminate and one pistillate and set in pits. Fruits round, 4–5 mm in diameter, turning from green to black when ripe.

DISTRIBUTION: Guatemala, Belize, Honduras, Nicaragua, Costa Rica, Panama, Colombia, Venezuela, Guyana, Surinam, French Guiana, Ecuador, Perú, Bolivia, Brazil.

In his revision of the geonomoid palms, Wessels Boer (1968) considered *G. deversa* to be the species of widest range, able to withstand many diverse ecological conditions. This species varies greatly in height and general vigor, depending on the availability of water and richness of the soil.

COMMON NAME: "Vávara" (Guahibo)

USES: Children make training bows from the stems. The pliable but strong stem also serves as a frame for fishing nets.

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PLATE 16

Plate 16. Aerial view of gallery forest formation along the rivers that traverse the open savannas in this region.

PLATE 17

Plate 17. Close-up aerial view of gallery forest composition.

PLATE 18

Plate 18. Young plants of *Mauritia flexuosa* growing in a seasonally inundated section of the savanna.

PLATE 19

Plate 19. Adult plants of *Mauritia flexuosa* growing in the gallery forest, where their presence is indicative of a moist area.

PLATE 20

Plate 20. *Desmoncus* sp. growing in one of the permanent streams of the gallery forest.

PLATE 21

Plate 21. Specimens of *Bactris* affin. *maraja* removed from the gallery forest understorey.

PLATE 22

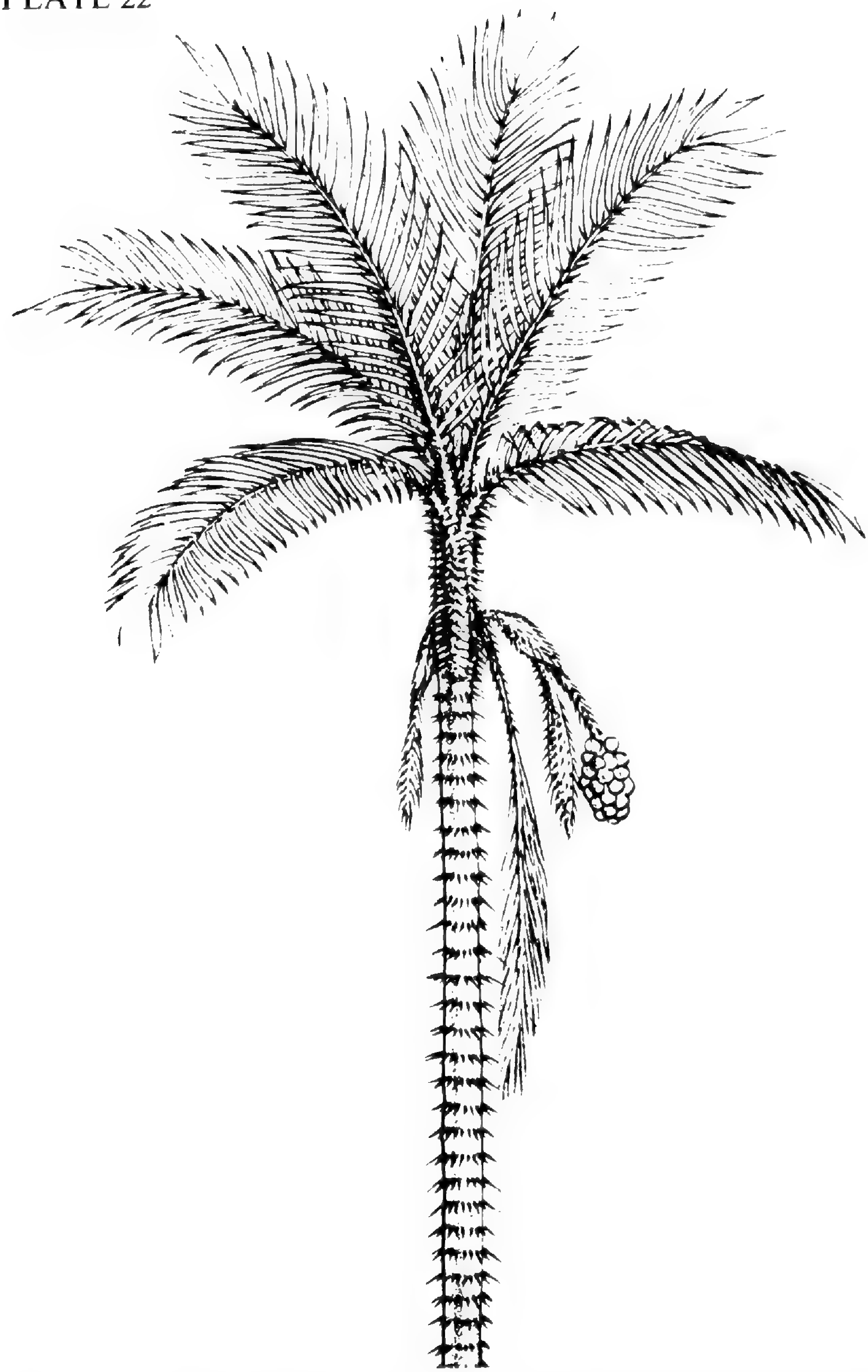

Plate 22. *Astrocaryum munbaca*, a low growing but stemmed member of this genus. Reproduced from Wallace (1853) where it is referred to as *A. gynacanthum* Mart.

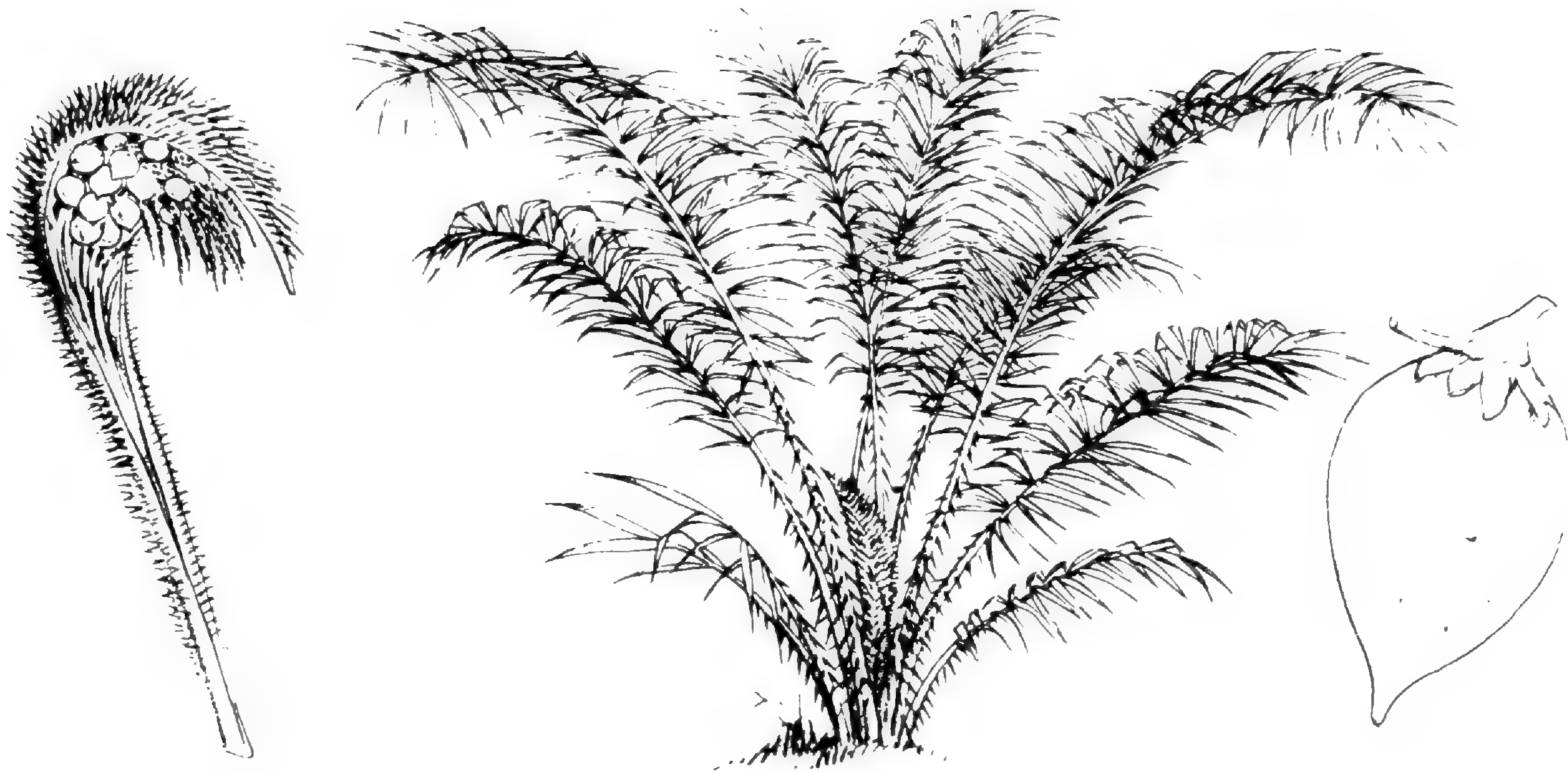

Plate 23. *Astrocaryum acaule,* a stemless palm, found in drier areas of the gallery forest, also reproduced from Wallace (1853).

PLATE 24

Plate 24. *Socratea exhorriza* growing in an open area of gallery forest.

PLATE 25

Plate 25. *Jessenia bataua,* here occuring as a solitary specimen having been protected near a stream, but usually found in dense stands in seasonally inundated areas.

PLATE 26

Plate 26. *Oencocarpus bacaba,* usually found in drier sites, here among young second-growth vegetation.

PLATE 27

Plate 27. *Oencarpus mapora,* occuring either in a caespitose or solitary habit. Here the caespitose form is shown, preserved in an agricultural field cleared of gallery forest for maize and cassava cultivation.

PLATE 28

Plate 28. *Maximiliana maripa* growing along the margins of the gallery forest.

PLATE 29

Plate 29. *Syagrus inajai,* common in the transition zone between gallery forest and savanna, and frequently also seen scattered in areas of pure savanna close to the gallery forest. Solitary palm in the upper right hand corner is *Euterpe precatoria.*

PLATE 30

Plate 30. *Euterpe precatoria*, found scattered throughout the gallery forest, and forming small groups of individuals in moist areas.

PLATE 31

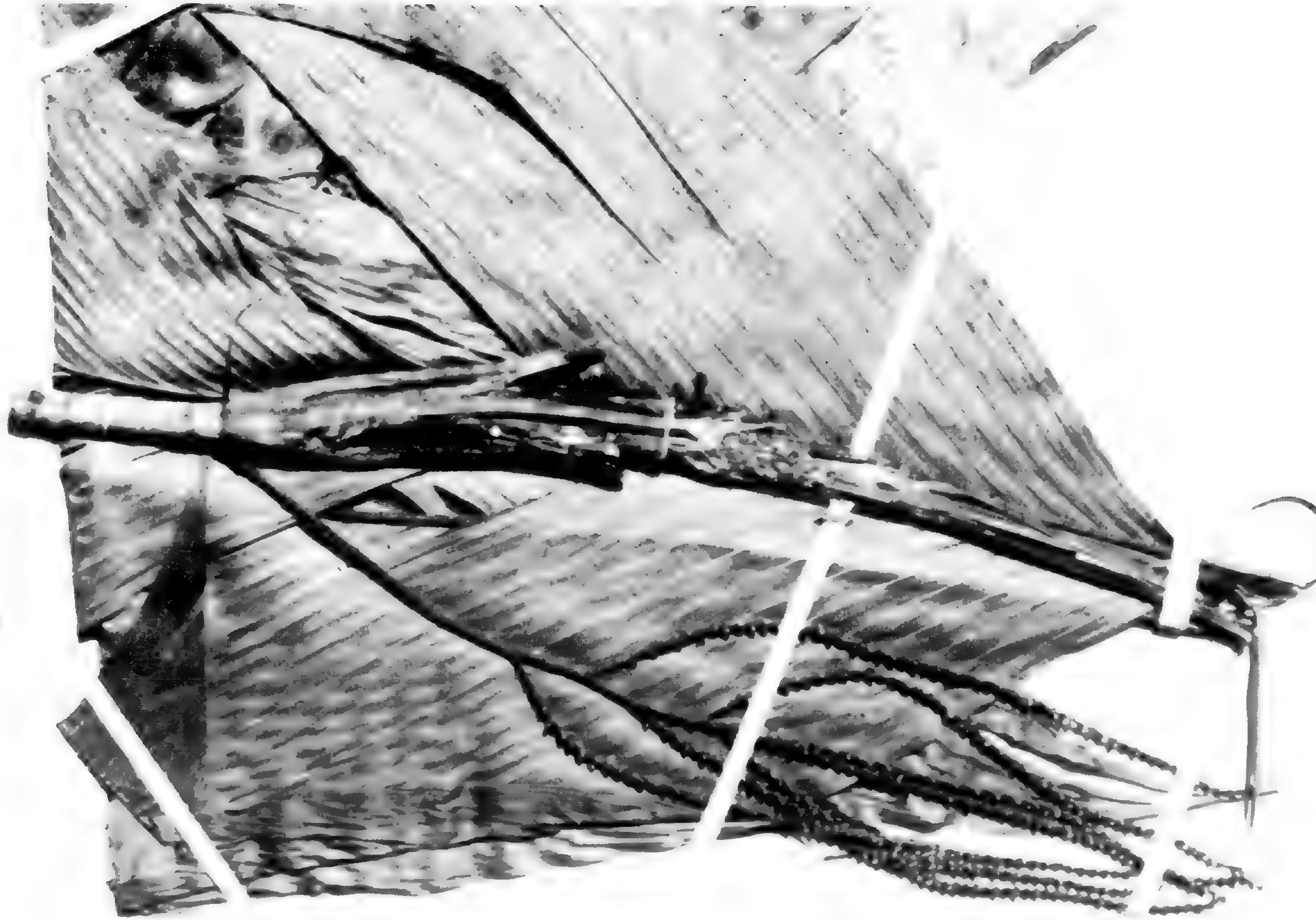

Plate 31. *Geonoma deversa*, the smallest palm in the "Las Gaviotas" area. Shown here is *I. Cabrera R.* no. 2406.

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A NOTE ON THE IDENTITY AND TYPIFICATION OF *GLOSSORHYNCHA KEYSSERI* SCHLTR.

Walter Kittredge

The purpose of this article is to clarify the identity of two closely related species of the genus *Glossorhyncha* which have been confused in recent literature.

During the course of an investigation into the subgeneric limits of the genus *Glossorhyncha* s.l., it was necessary to examine the type specimens of the nomenclatural types of the genera belonging to the subtribe Glomerinae. While studying the type of one of these genera, *Giulianettia tenuis* Rolfe, it became apparent that there were two distinct species combined by van Royen within the circumscription of *G. tenuis* in his Alpine Flora of New Guinea. Through a study of the original descriptions in this group it became evident that the second species had already been described as *Giulianettia Keysseri* by Schlecter in 1919. This latter species was subsequently transferred to *Glossorhyncha* by van Royen and neotypified in his flora. His choice of Womersley NGF 24808 for the neotype of *G. Keysseri* is unfortunate because it does not agree with the details of Schlecter's original description. The flowers of *G. Keysseri* were described as having recurved sepals 13 mm. long and a lip blade broadly rhombic, 3 × 3 mm. with a filiform spur. The clinandrium was stated to be low and obtuse, while the bracts were noted as being equal in length. The plant was characterized as having a slender growth habit. van Royen's neotype does not exhibit any of these characters. Womersley's plant is very stout with much larger flowers. The sepals are not recurved, the lip blade is larger, 7 × 6 mm. with a stout spur, and the clinandrium is high and strongly crenulate. In addition, the inner bract is much longer than the outer one. Consequently, van Royen's choice of a neotype for *G. Keysseri* must be rejected since it was based on a misidentification. On the other hand, I find that Hartley 11235 from near the type locality agrees remarkably well with Schlecter's original description; therefore I am selecting it as a new neotype. I have identified the Womersley specimen with *G. subalpina* van Royen extending its range eastward from the type station on Mt. Wilhelmina in Irian Java.

Key To The Species

1. Leaves subterete; outer bracts chartaceous, striate; flowers green .... 1. **G. tenuis**

1a. Leaves flat; outer bracts thin, smooth; flowers flesh-colored .... 2. **G. Keysseri**

1. **Glossorhyncha tenuis** (Rolfe) van Royen, Fol. Geobot. Phytotax. 9: 84, 1974.

   Basionym: *Giulianettia tenuis* Rolfe, Hook. Ic. Pl. 27: t. 2616, 1899.

   Holotype: Giulianetti s.n. (K).

   Papua New Guinea. *Central Prov.:* Owen Stanley Range, Mt. Scratchley, 13200 ft., Giulianetti s.n. (K). Repeater Station, 11000 ft., Coode & Stevens NGF 46310 (AMES, E). Southwest slope of Mt. Albert-Edward, 3680 m., Brass 4331 (AMES, NY). West side, 3600 m., Brass 4250 (AMES, NY). Croft et al LAE 61391 (AMES, E).

   Note: Fig. 208 of *G. tenuis* in The Alpine Flora of New Guinea is *G. Keysseri.*

2. **Glossorhyncha Keysseri** (Schltr.) van Royen, Alp. Fl. New Guinea 2: 608, 1979.

   Basionym: *Giulianettia Keysseri* Schltr., Fedde, Rep. 16: 216, 1919.

   Holotype: Keysser s.n. (B, destroyed).

   Neotype: Hartley 11235 (AMES) *in hoc loco*!

   Papua New Guinea. *Central Prov.:* Owen Stanley Range, above the Gap, 8000 ft., Carr 10471 (AMES, NY). *Eastern Highlands Prov.:* Chimbu Valley, Mt. Wilhelm, 8000 ft., Robbins 664 (AMES). Kombugomambuno, 3300 m., Balgooy 503 (AMES). Vandenberg NGF 39635 (K). *Morobe Prov.:* Bakara, Mt. Sarawaket, 8500 ft., Hartley 12781 (AMES). 10000 ft., Hartley 11235 (AMES). *Southern Highlands Prov.:* South slope of Mt. Giluwe, 2550 m., Croft et al LAE 60735 (AMES). 11,500 ft., Vandenberg et al NGF 39764 (AMES, E). North slope of Mt. Kerewa, 3150 m., Kalkman 4803 (AMES).

NOTE: Fig. 213 of van Royen's neotype of *G. Keysseri* in The Alpine Flora of New Guinea is *G. subalpina.*

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ELSO STERRENBERG BARGHOORN 1915–1984 AN APPRECIATION

REED C. ROLLINS

Elso Sterrenberg Barghoorn, Fisher Professor of Natural History, Harvard University, Cambridge, died of undetermined natural causes at his home in Carlyle, Massachusetts, January 22, 1984. He was born in New York City on June 30, 1915, and spent most of his early life in Dayton, Ohio.

Barghoorn was a paleobotanist of considerable international stature who brought to the subject a multifaceted approach. He led away from the traditional field that had developed on the borderline between botany and geology, that concerned itself largely with the description of fossil plants and fossil floras, and too often oriented to aid geologists in the study of stratigraphic sequences and correlations. His interests and contributions ranged widely to include techniques of experimentation as well as historical and observational methods of research, and his subject matter was equally diverse. He treated paleobotany as an interdisciplinary field of science and in doing so stressed evolutionary theory, comparative morphology, organic geochemistry, historical geology, plant geography, and archeology.

Elso Barghoorn was at the forefront of studies of the origin and antiquity of life on the earth. It was a bold move to recognize and point to evidence for the existence of structurally preserved plants about one and a half billion years old in Precambrian rocks of the Canadian Shield which he did with Stanley Tyler in 1954. Just how bold can be judged by the fact that prior to this and subsequent evidence, most of the Precambrian was regularly dismissed as being irrelevant as far as life on the earth was concerned. Since the first impact of the idea that life might have originated so far back in the earth's history, research on Precambrian fossils has blossomed into a major research effort and in a major way has been led by Barghoorn and his students. Now we hear dates of three and one half billion years and the suggestion of even older dates for the origin of life. At the same time he was looking for cells and microorganisms in those ancient rocks, Elso was also looking for evidence of organic compounds that might have had their origin from living organisms. In this he was following a natural spin-off from his earlier interest in the degradation of organic materials by living micro-organisms, a study in which he was engaged during World War II under the auspices of the Office of Scientific Research and Development and assigned to the Quartermaster Corps of the United States Army.

Elso Barghoorn might very well have been a systematic botanist had his early inclinations been followed. During his undergraduate years, he worked as a student in the herbarium at Miami University in Oxford, Ohio, where he received an A.B. with honor in 1937. In applying to Harvard University for graduate study, he corresponded with M. L. Fernald, expressing his desire to do his thesis in taxonomic botany. He wrote Fernald, "For some time I have been interested in the Ericaceae as a group, and in particular those of the north-eastern United States." However, when he did come to Harvard in the fall of 1937, he at first elected to study developmental morphology under R. H. Wetmore who, upon learning of Elso's deep interest in cell and wood structure, suggested the appropriate person to work with would be I. W. Bailey. Thus the sponsorship through his graduate years was influenced and Bailey became his major professor. From Harvard, he received an A.M. degree in 1938 and a Ph.D. in 1941.

After a summer on a Sheldon Fellowship at Harvard's Atkins Garden and Research Laboratory in Cienfuegos, Cuba, Elso accepted an instructorship at Amherst College, Amherst, Massachusetts, beginning in the fall of 1941. One of his duties was to oversee the care of the college herbarium. He became an Assistant Professor in 1944, but was given a leave of absence to engage in war research almost immediately. After the war he became Assistant Professor at Harvard (1946–1949), Associate Professor (1949–1955) and Professor (1955–1973). In 1973, he was appointed to the famous professorship (Fisher Professor of Natural History) first held by Asa Gray and successively by M. L. Fernald, F. L. Hisaw, Paul C. Mangelsdorf, and Frank L. Carpenter. He served as Curator of the Paloebotanical Collections of the Botanical Museum, beginning in 1948, and by invitation he was a member of the faculty of the Department of Geology of the University from 1946 onward.

Tracing Barghoorn's botanical career shows connections between a series of diverse disciplines that cannot but evoke admiration for the man who was able to encompass such a broad spectrum of scientific endeavor. His early studies on xylem rays in conifers and dicotyledons found an outlet in a fortuitous and innovative piece of work that helped to restore the early colonial Saugus Iron Works in Saugus, Massachusetts, which has now become a United States National Monument. The problem was how to restore half-decomposed wood which had been buried in muck and peat for several hundred years to a state where it could be safely used in the reconstruction. His ingenuity in cleaning the material with a mild acid and embedding the remaining tissue with parafin on a grand scale and over a relatively long period eventually allowed the restoration to proceed. Elso liked challenges brought from the work-a-day world. His analysis of wood fragments from an Indian fishweir uncovered by excavations for a tall building in Boston showed that the fishweir was in operation over 2,500 years ago. I will always remember the enthusiasm he showed when several husky students lugged to him a heavy rounded chunk of partially deteriorated material that had been dug up during construction near the Charles River. It had the marks of a real mystery. But it wasn't long before he had determined that the material had a high carbon content and other characteristics leading to an indication that it was a latex of some sort. Further investigation proved it to be rubber and the object turned out to be a big ball of rubber latex still unrefined and probably in the mold it had been received from the Brazilian jungles by a rubber factory. In these instances, he was looking at recently buried materials but he often became concerned with those of archeological age and older. He utilized these to examine the changes in sea level along the New England coast and later, after studying salt marshes, brought a wide range of data to bear on the problem of sea level changes on the coast of eastern North America. When fossil and archeological material of maize became available from exploration and deep core drilling for the Mexico City subway system, it was almost a given that Barghoorn would become involved to help evaluate the findings. With Paul Manglesdorf, the maize specialist, cheering on the sidelines, Elso and his students brought the evidence from ancient maize and its relatives to bear on the problem of the origins of maize itself. Interwoven with his work on archeological materials were studies linking recent fossils to climatic change and the nature of paleoclimates.

The Brandon Lignite, an early tertiary coal, found on a site near Brandon, Vermont, was known for a long time as a rich source of fossil angiosperm fruits and seeds. But Elso felt that the deposit had not been adequately explored. The old quarry where the original discoveries were made was abandoned years ago and became grown over to a substantial degree. Relocating the deposit was a challenge that consumed a whole summer of drilling. When he was about to give up on the project, Elso and his assistants discovered they had been walking over the deposit much of the summer. Besides his own research on it, the material extracted from the Brandon site has provided the basis for several Ph.D. theses by Barghoorn's students, and has contributed substantially to our knowledge of tertiary plants. The relationship of these to the present flora of southeastern North America is a truly remarkable story.

The genius of Barghoorn's insights in revealing the presence and nature of the earth's most ancient life cannot be denied, but it is interesting to speculate as to whether such discoveries would have been made had he not had the special combination of talents he actually possessed. Here was a man trained under a superb microscopist and rigorous scientist, I. W. Bailey, who almost literally embodied the sentiments of inquiry, and was a strong influence on his student. Thus, Elso himself became an excellent microscopist, and fortunately, at the same time he added many aspects of organic chemistry to his mastery of technical procedures. Then early in his career, he became involved in microbial deterioration of organic substances during which he was forced to become intimately acquainted with a long list of diverse microorganisms. Incidentally, it was during this period that he proved, despite the sceptics, that certain marine microorganisms were involved in wood decay. At any rate, he was uniquely prepared to recognize evidence of organic substances in very old Precambrian rocks and when he looked for organisms that might have been responsible, he naturally was looking on the microscopic level. His laboratory prowess in producing thin sections and handling other procedures connected with the preparation of suitable microscope slides were happily combined with his other talents to give the net results that are now evident.

Barghoorn's contributions to botany will stand on their own merits and I am in no position to give a critical evaluation of them. But looking at Elso as a colleague, I always viewed him as having a very original mind, and possessed of a great breadth of knowledge that was accurate to a degree where accuracy for its own sake was a noticeable component of his make-up. He had a tremendous enthusiasm for science and pursued his own area by ably planning research that often coordinated with related fields. His broad botanical interests and experience and an indefatigable industry led to substantial accomplishments on a broad front. Although one of my colleagues lamented, "It has taken a long time for botanists and paleobotanists in particular to appreciate his ability and contributions, but he is now so highly regarded by geologists, chemists, and other scientists that they can no longer brush him aside," I do not feel he has been seriously overlooked. After all, he was elected to the National Academy of Sciences in 1967 and was awarded the Botanical Society of America Certificate of Merit in 1968. Jointly with his student, J. W. Schopf, he was presented the New York Botanical Garden Award in 1966, ". . .for outstanding contributions to the fundamental aspects of botany." In 1968 he was awarded the Hayden Memorial Geological Award of the Academy of Natural Sciences of Philadelphia, and in 1972, the National Academy of Sciences awarded him the Charles Doolittle Wolcott Medal for research in Precambrian life. Of course, Elso's most enduring memorial rests with his students and close associates whom he tutored in the rigors of scientific thought and methodology. Many of these are strategically placed in positions where they have made or are making their own impact in the field that he had a large hand in rejuvinating. (Based on report in Taxon 33:557–560, 1984.)

PLATE 32

Plate 32. Elso Sterrenberg Barghoorn. Courtesy of Harvard University News Office.

NOTES FROM THE AMES ORCHID HERBARIUM

Leslie A. Garay and Walter Kittredge

During the last five years in discharging curatorial duties, it has been the practice in the Ames Orchid Herbarium to accumulate nomenclatorial notes about species which have been found wrongly classified, albeit the actual nomenclatorial transfers are still wanting publication. The following nomenclatorial transfers were mostly accumulated during the systematic reorganization of the whole Orchid Herbarium. The impetus to publish these findings is primarily derived from the publication of the genus *Hapalochilus* Senghas, in 1978, a segregate from *Bulbophyllum* Thou. The genus is, indeed, a well circumscribed one, but unfortunately only the type of the genus was originally transferred. In the meantime *Hapalochilus* was also treated as part of the Bulbophyllum-complex in the 3rd and revised edition of Schlechter, Die Orchideen, in 1983, without any further transfers or additions to the genus. Since *Hapalochilus* is a good genus, it appeared advisable to separate out the remaining 65 species in the herbarium which were scattered among the some 1,200 species in the genus *Bulbophyllum*. We wish to emphasize that these transfers are not routine rubber-stampings, but are the results of individual investigations of actual types or records of types. The genera and species are arranged alphabetically.

Amitostigma keiskeoides (Gagnep.) Garay & Kittr., *comb. nov.*
Basionym: *Habernaria keiskeoides* Gagnep. in Bull. Soc. Bot. Fr. 78: 71, 1931.

The genus *Amitostigma* is new to Vietnam

Beadlea Pringlei (S. Wats.) Garay & Kittr., *comb. nov.*
Basionym: *Spiranthes Pinglei* S. Wats. in Proc. Amer. Acad. 26: 153, 1891.

In the generic revision of the Spiranthinae by Garay, *Spiranthes Pringlei* was listed erroneously as being a synonym of *Beadlea saccata* (Rich. & Gal.) Garay. It is *S. Pringlei var. minor* Greenm. which is the synonym rather than the species.

Didymoplexis pachystomoides (F. Muell.) Garay & Kittr., *comb. nov.*

Basionym: *Pogonia pachystomoides* F. Muell., Fragm. Phyt. Austr. 8: 174, 1874.

Syn.: *Nervilia pachystomoides* (F. Muell.) Schltr. in Engl., Bot. Jahrb. 45: 404, 1911.

Judging from the record of the type, this species, known only from the type, is unquestionably referable to *Didymoplexis*. The genus is new to Australia.

Diplolabellum confluens (Hand.-Mazt.) Garay & Kittr., *stat. nov.*

Basionym: *Oreorchis patens var. confluens* Hand.-Mazt., Symb. Sinic. 7(2): 1353, 1936.

The convergent, V-shaped callus on the lip clearly refers this species to the genus *Diplolabellum* Maekawa.

Epicranthes Bl.

The unique branching habit of the rhizome which is covered with silvery grayish sheaths and the very dactylate petals with movable ornaments readily separates this genus from *Bulbophyllum*. The following species comprise this old genus established in 1825.

Epicranthes abbrevilabia (Carr) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum abbrevilabium* Carr in Gard. Bull. S. S. 7: 18, 1932.

Epicranthes adangensis (Seidenf.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum adangense* Seidenf. in Dansk Bot. Ark. 33(3): 37, 1979.

Epicranthes annamensis Guillaum. in Bull. Mus. Nat. Hist. Nat. Paris, ser. 2, 28: 486, 1956.

Epicranthes cheiropetalum (Ridl.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum cheiropetalum* Ridl. in Kew Bull. 477, 1926.
Syn.: *Bulbophyllum manipetalum* J. J. Sm. in Fedde, Rep. 36: 117, 1934.

Epicranthes chlororhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum chlororhopalon* Schltr. in Fedde, Rep. Beih. 1: 881, 1913.

Epicranthes cimicina (J. J. Verm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum cimicinum* J. J. Verm. in Selbyana 7: 20, 1982.

Epicranthes conchophylla (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum conchophyllum* J. J. Sm. in Fedde, Rep. 11: 133, 1912.

Epicranthes Corneri (Carr) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum Corneri* Carr in Gard. Bull. S. S. 7: 16, 1932.

Epicranthes decarhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum decarhopalon* Schltr. in Fedde, Rep. Beih. 1: 880, 1913.

Epicranthes javanica Bl., Bijdr. pt. 7: 307, Tab. fig. 9, 1825.
Syn: *Bulbophyllum Epicrianthes* Hook. f., Fl. Br. Ind. 5: 753, 1890.
Bulbophyllum javanicum var. sumatranum J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 3, 2: 85, 1920.
Bulbophyllum Epicrianthes var. sumatranum (J. J. Sm.) J. J. Verm. in Selbyana 7: 20, 1982.

Epicranthes flavofimbriata (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum flavofimbriatum* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 3, 11: 143, 1931.

Epicranthes Haniffii (Carr) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum Haniffii* Carr in Gard. Bull. S. S. 7: 20, 1932.

Epicranthes heterorhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum heterorhopalon* Schltr. in Fedde, Rep. Beih. 1: 882, 1913.

Epicranthes hexarhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum hexarhopalon* Schltr. in Engl., Bot. Jahrb. 39: 83, 1906.

Epicranthes hirudinifera (J. J. Verm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum hiridiniferum* J. J. Verm. in Selbyana 7: 24, 1982.

Epicranthes Johannulii (J. J. Verm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum Johannulii* J. J. Verm. in Selbyana 7: 22, 1982.

Epicranthes macrorhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum macrorhopalon* Schltr. in Fedde, Rep. Beih. 1: 882, 1913.

Epicranthes mobilifilum (Carr) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum mobilifilum* Carr in Gard. Bull. S. S. 5: 7, 1929.

Epicranthes octorhopalon (Seidenf.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum octorhopalon* Seidenf. in Bot. Tidsskr. 70(1): 88, 1975.

Epicranthes papillosofilum (Carr) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum papillosofilum* Carr in Gard. Bull. S. S. 5: 9, 1929.

Epicranthes phymatum (J. J. Verm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum phymatum* J. J. Verm. in Selbyana 7: 22, 1982.

Epicranthes psilorhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum psilorhopalon* Schltr. in Fedde, Rep. Beih. 1: 881, 1913.

Epicranthes rigidifilum (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum rigidifilum* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 3, 2: 85, 1920.

Epicranthes stenorhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum stenorhopalon* (as stenorhopalos) Schltr. in Fedde, Rep. 17: 380, 1921.

Epicranthes trirhopalon (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum trirhopalon* Schltr. in Fedde, Rep. Beih. 1: 883, 1913.

Epicranthes undecifila (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum undecifilum* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 3, 9: 51, 1927.

Epicranthes vesiculosa (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum vesiculosum* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 2, 25: 63, 1917.

Hapalochilus (Schltr.) Senghas

The characters of this genus are very distinct from those found in *Bulbophyllum*. The long, arcuate column is footless, tumid at base and the lip is adnate to it immovably; the clinandrium has lacerate ears. None of these characters are present in the genus *Bulbophyllum*. All of the *Hapalochilus* species are native to New Guinea with the exception of *H. Jensenii* which is described from the island of Ambon in the Indonesian Moluccas.

Hapalochilus acanthoglossus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum acanthoglossum* Schltr. in Fedde, Rep. Beih. 1: 727, 1913.

Hapalochilus algidus (Ridl.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum algidum* Ridl. in Trans. Linn. Soc. ser. 2, Bot. 9: 181, 1916.

Hapalochilus alkmaarense (J. J. Sm.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum alkmaarense* J. J. Sm. in Bull. Dept. Agric. Ind. Neerl. 45: 7, 1911.

Hapalochilus alticola (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum alticola* Schltr. in Fedde, Rep. Beih. 1: 715, 1912.

Hapalochilus aristilabris (J. J. Sm.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum aristilabre* J. J. Sm., in Fedde, Rep. 11: 278, 1912.

Hapalochilus arfakense (J. J. Sm.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum arfakense* J. J. Sm. in Gibbs, Contr., Phytog. & Fl. Arfak Mts. 122, 1917.

Hapalochilus aureoapex (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum aureoapex* Schltr. in Fedde, Rep. Beih. 1: 723, 1913.

Hapalochilus brevis (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum breve* Schltr. in Fedde, Rep. Beih. 1: 730, 1913.

Hapalochilus callipes (J. J. Sm.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum callipes* J. J. Sm. in Bull. Dept. Agric. Ind. Neerl. 19: 5, 1908.

Hapalochilus caudatipetalum (J. J. Sm.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum caudatipetalum* J. J. Sm. in Fedde, Rep. 12: 401, 1913.

Hapalochilus chrysochilus (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum chrysochilum* Schltr. in Fedde, Rep. Beih. 1: 718, 1912.

Hapalochilus chrysoglossus (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum chrysoglossum* Schltr. in Schum. & Lauterb, Nachtr. Fl. Deutsch. Schutzg. 198, 1905.

Hapalochilus collinus (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum collinum* Schltr. in Fedde, Rep. Beih. 1: 73;, 1913.

Hapalochilus coloratus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum coloratum* J. J. Sm. in Bull. Dept. Agric. Ind. Neerl. 39: 2, 1911.

Hapalochilus concavibasalis (van Royen) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum concavibasalis* van Royen, Alp. Fl. N. Guinea 2: 167, 1979.

Hapalochilus concolor (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum concolor* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 2, 13: 66, 1914.

Hapalochilus cruciatus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum cruciatum* J. J. Sm. in Bull. Dept. Agric Ind. Neerl. 45: 8, 1911.
Syn.: *Bulbophyllum immobile* Schltr. in Fedde, Rep. Beih. 1: 724, 1913.

Hapalochilus cucullatus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum cucullatum* Schltr. in Fedde, Rep. Beih. 1: 708, 1912.

Hapalochilus cuniculiformis (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum cuniculiforme* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser 2, 2: 16, 1911.

Hapalochilus decurvulus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum decurvulum* Schltr. in Fedde, Rep. Beih. 1: 716, 1912.

Hapalochilus dolichoglottis (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum dolichoglottis* Schltr.in Fedde, Rep. Beih. 1: 715, 1912.

Hapalochilus fasciatus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum fasciatum* Schltr. in Fedde, Rep. Beih. 1: 713, 1912.

Hapalochilus fibrinus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum fibrinum* J. J. Sm. in Fedde, Rep. 12: 402, 1913.

Hapalochilus formosus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum formosum* Schltr. in Fedde, Rep. Beih. 1: 712, 1912.

Hapalochilus frustrans (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum frustrans* J. J. Sm. in Bull. Dept. Agric. Ind. Neerl. 45: 8, 1911.

Hapalochilus geniculifer (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum geniculiferum* J. J. Sm. in Fedde, Rep. 11: 276, 1912.

Hapalochilus gobiensis (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum gobiense* Schltr. in Fedde, Rep. Beih. 1: 717, 1912

Hapalochilus holochilus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum holochilum* J. J. Sm. in Fedde, Rep. 11: 139, 1912.

Hapalochilus humilis (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum humile* Schltr. in Fedde, Rep. Beih. 1: 730, 1913.

Hapalochilus inclinatus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum inclinatum* J. J. Sm. in Nova Guin. 18: 57, 1934.

Hapalochilus jadunae (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum jadunae* Schltr. in Fedde, Rep. Beih. 1: 720, 1912.

Hapalochilus Jensenii (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum Jensenii* J. J. Sm. in Bull. Jard, Buitenz, ser. 3, 8: 57, 1926.

Hapalochilus kelelensis (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum kelelense* Schltr. in Fedde, Rep. Beih. 1: 722, 1913.

Hapalochilus kermesinus (Ridl.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum kermesinum* Ridl. in Journ. Bot. 24: 325, 1899.

Hapalochilus leontoglossus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum leontoglossum* Schltr. in Fedde, Rep. Beih. 1: 722, 1913.

Hapalochilus leucorhodus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum leucorhodum* Schltr. in Fedde, Rep. 1: 724, 1913.

Hapalochilus longilabris (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum longilabre* Schltr. in Fedde, Rep. Beih. 1: 714, 1912.

Hapalochilus melinoglossus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum melinoglossum* Schltr. in Fedde, Rep. Beih. 1: 721, 1913.

Hapalochilus microrhombos (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum microrhombos* Schltr. in Fedde, Rep. Beih. 1: 719, 1912.

Hapalochilus monosema (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum monosema* Schltr. in Fedde, Rep. Beih. 1: 727, 1913.

Hapalochilus mutatus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum mutatum* J. J. Sm. in Nova Guin. 12: 368: 1916.

Hapalochilus mystrochilus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum mystrochilum* Schltr. in Fedde, Rep. Beih. 1: 721, 1913.

Hapalochilus novae-hiberniae (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum novae-hiberniae* Schltr. in Schum. Lauterb., Nachtr. Fl. Deutsch. Schutzg. 211, 1905.

Hapalochilus olorinus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum olorinum* J. J. Sm. in Fedde, Rep. 11: 277, 1912.

Hapalochilus oxyanthus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum oxyanthum* Schltr. in Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzg. 213, 1905.

Hapalochilus pemae (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum pemae* Schltr. in Fedde, Rep. Beih. 1: 725, 1913.

Hapalochilus quadricaudatus (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum quadricaudatum* J. J. Sm. in Bull. Dept. Agric. Ind. Neerl. 45: 10, 1911.

Hapalochilus rectilabris (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum rectilabre* J. J. Sm. in Fedde, Rep. 11: 277, 1912.

Hapalochilus reflexus Garay & Kittr., *nom. nov.*
Basionym: *Bulbophyllum rhynchoglossum* Schltr. in Fedde, Rep. Beih. 1: 716, 1912, not Schltr. 1910.

Hapalochilus Scaphosepalum (Ridl.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum Scaphosepalum* Ridl. in Trans. Linn. Soc. ser. 2, Bot. 9(1): 180, 1916.

Hapalochilus schizopetalum (L. O. Wms.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum schizopetalum* L. O. Wms. in Bot. Mus. Leafl. 12: 164, 1946.

Hapalochilus scitulus (Ridl.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum scitulum* Ridl. in Trans. Linn. Soc. ser. 2, Bot. 9(1): 181, 1916.

Hapalochilus scyphochilus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum scyphochilum* Schltr. in Fedde, Rep. Beih. 1: 708, 1912.

Hapalochilus speciosus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum speciosum* Schltr. in Fedde, Rep. Beih. 1: 712, 1912.

Hapalochilus stabilis (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum stabile* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 2, 2: 16, 1911.

Hapalochilus stellula (Ridl.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum stellula* Ridl. in Trans. Linn. Soc. ser. 2, Bot. 9(1): 182, 1916.

Hapalochilus stenophyton Garay & Kittr., *nom. nov.*
Basionym: *Bulbophyllum stenophyllum* Schltr. in Fedde, Rep. Beih. 1: 719, 1912, not Ridl. 1907.

Hapalochilus stictanthus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum stictanthum* Schltr. in Fedde, Rep. Beih. 1: 726, 1913.

Hapalochilus striatus Garay & Kittr., *nom. nov.*
Basionym: *Bulbophyllum pulchrum* Schltr. in Fedde, Rep. Beih. 1: 710, Dec. 1912, not J. J. Sm. Oct. 1912.

Hapalochilus torricellensis (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum torricellense* Schltr. in Fedde, Rep. Beih. 1: 728, 1913.

Hapalochilus trachyglossus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum trachyglossum* Schltr. in Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzg. 217, 1905.

Hapalochilus trigonocarpus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum trigonocarpum* Schltr. in Schum. & Lauterb., Nachtr. Fl. Deutsch. Schutzg. 218, 1905.

Hapalochilus warianus (Schltr.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum warianum* Schltr. in Fedde, Rep. Beih. 1: 726, 1913.

Hapalochilus xanthoacron (J. J. Sm.) Garay & Kittr., *comb. nov.*
Basionym: *Bulbophyllum xanthoacron* J. J. Sm. in Bull. Dept. Agric. Ind. Neerl. 45: 10, 1911.

Hapalochilus xanthophaeus (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Bulbophyllum xanthophaeum* Schltr. in Fedde, Rep. Beih. 1: 729, 1913.

Hymenorchis serrulata (Hallé) Garay, *comb. nov.*

Basionym: *Saccolabium serrulatum* Hallé in Bull. Mus. Nat. Hist. Nat. Paris ser. 3, Sect. B, Adans. 4: 410, 1981.

The excellent illustrations by Dr. Hallé leaves no doubt that it is a new member of the genus *Hymenorchis* Schltr. The serrate leaves, the structure of the pollinia and the delicate white flowers among others are the characters upon which Schlechter based his genus. The species are basically native to New Guinea with the exception of *H. javanica* (T. & B.) Schltr. and *H. Vanoverberghii* (Ames) Garay from the Philippines. *Hymenorchis serrulata* is surprisingly very close to *H. javanica,* rather than to any of the New Guinea species.

Pleurothallis jalapensis (Krzl.) Garay, *comb. nov.*

Basionym: *Masdevallia jalapensis* Krzl. in Fedde, Rep. Beih. 34: 117, 1925.

It is a mystery why Kraenzlin called this species a *Masdevallia.* It belongs to a small group of closely related species, but readily identifiable by the long acuminate, appressed bracts. The following species comprise this natural group: *P. Liebmanniana* Krzl., *P. cobanensis* Schltr., *P. multirostris* Rchb.f. and *P. racemiflora* (Sw.) Lindl.

Sarcoglyphys potamophila (Schltr.) Garay & Kittr., *comb. nov.*

Basionym: *Sarcanthus potamophilus* Schltr. in Fedde, Rep. 3: 279, 1907.

Syn.: *Cleisostoma potamophilum* (Schltr.) Garay in Bot. Mus. Leafl. 23: 173, 1972.

At the time when the genus *Sarcoglyphys* was established, the highly elevated anther bed has been overlooked in Schlechter's drawing. The genus is new to Borneo.

Tainia ovalifolia (Ames & Schwenf.) Garay & Kittr., *comb. nov.*
Basionym: *Eulophia ovalifolia* Ames & Schweinf. in Ames, Orchid. 6: 208, 1920.

It is difficult to understand why this plant has been referred to the genus *Eulophia.* In floral details it approaches *T. hastata* (Lindl.) Hook. f. from India which, however, is proportionately a much larger plant.

Zeuxine ovata (Gaud.) Garay & Kittr., *comb. nov.*
Basionym: *Nervilia ovata* Gaud. in Voy. Aut. Monde, Bot. 422, 1829.

An examination of the type kept in Paris and a photographic record of it confirms Schlecter's contention that this plant is a member of the Physurinae-complex.

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DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICAL COMMENTATIONES XXXVI.

A NOVEL METHOD OF UTILIZING THE HALLUCINOGENIC BANISTERIOPSIS.

Richard Evans Schultes

The hallucinogen so widely employed in the western Amazon and along the Pacific coastal region of Colombia—variously known as *ayahuasca, caapi, natema, pindé* or *yajé*—is almost exclusively prepared as a drink (Schultes: Bot. Mus. Leafl., Harvard Univ. 18 (1957) 1–56). The basic ingredient is the bark of either *Banisteriopsis Caapi* or *B. inebrians,* two forest lianas of the Malpighiaceae which have psychoactive β-carboline alkaloids: harmine, harmaline and tetrahydoharmine. Frequently other plants are used as additives—a number of species in sundry families, some of which are known to contain various psychoactive principles (Rivier, L. et J.-E Lindgren: Econ. Bot. 26 (1972) 101–129). There are two plants, however, that are added to the drink over a wide area to increase and lengthen the intoxication: the leaves of *Diplopteris Cabrerana* (formerly known as *Banisteriopsis Rusbyana*) of the Malpighiaceae and the leaves of the rubiaceous *Psychotria viridis* (Schultes et Hofmann: *The Botany and Chemistry of Hallucinogens* (Ed. 2, 1979) 163–185; der Marderosian, A., H. V. Pinkley et M. F. Dobbins; Am. Journ. Pharm. 140 (1968) 137–147).

This malpighiaceous narcotic preparation has been studied by scores of botanists, ethnobotanists, anthropologists, pharmacologists and phytochemists and its use reported by many travellers and explorers for more than a century since the identification by the British plant explorer Richard Spruce who collected the type material of *Banisteriopsis Caapi* in 1851

(Spruce R. [Ed. A. R. Wallace] *Notes of a Botanist on the Amazon and Andes 2* (1908) 413–425). All reports have indicated that the bark is prepared as either a decoction or infusion and is ceremonially drunk.

During a recent brief visit to Araracuara on the Río Caquetá in the Comisaría del Amazonas of Colombia, it was discovered that the Witoto Indians, who cultivate *Banisteriopsis Caapi,* do not employ it as a drink but smoke the dried and crushed leaves and young bark. Although the Andoques, who live in the same area, apparently use *Banisteriopsis* as a drink, there is evidence not yet fully substantiated that they likewise smoke the drug; but their usual employment of it is as a drink (La Rotta: Univ. Nac., Colombia, Dept. Biología, Corporación de Araracuara, *Observaciones Etnobotánicas sobre Algunas Especies Utilizadas por la Comunidad Indígena Andoque* (1983) 58–59).

Several juvenile, cultivated plants of *Banisteriopsis Caapi* were noted in the locality. Conversation with a knowledgeable Witoto medicine man indicated that leaves are dried, broken into small pieces and prepared in cigarette-form in pieces of the leaves of the *Heliconia* plant. It is smoked in ceremonies by medicine men for its vision-producing properties. It is never smoked with tobacco for, according to the Indians, the intoxication produced would be extremely strong and long-lasting and would induce very unpleasant after-effects.

The Witotos call *Banisteriopsis Caapi oo'-na-oo.* The Andoques recognize several "kinds" of the yajé liana, "according to the spirit of the animal that possesses the person who has initiated the taking of the drink: with *iñotaino'*, the person is transformed into a jaguar; with *hapataino',* into a boa; and with *kadanytaino',* into a hawk" (La Rotta: loc. cit.).

The Witoto Indians are noteworthy in using biodynamic plants in ways that differ markedly from those of other neighbouring tribes in the northwestern Amazonia.

Instead of preparing a psychoactive snuff from species of the myristicaceous *Virola,* for example, they—together with their neighbours, the Boras—prepare pellets or "pills" from the resin-like exudate of the bark of several species of *Virola* for hallucinogenic purposes (Schultes: Bot. Mus. Leafl., Harvard Univ. 22 (1969) 229–240; Schultes, Swain et Plowman: loc. cit. 25 (1977) 259–272).; Aboriginally, instead of smoking tobacco communally, they consume it, together with coca, as a thick liquid called *ambíl* which they smear on the upper gums (Schultes: Agric. Trop. No. 9 (1945) 19–22). Many other aspects of the ethnopharmacological use of plants amongst the Witotos suggest that their pharmacopeal knowledge is extensive and distinct.

Banisteriopsis Caapi (*Spr. ex Griseb.*) Morton in Journ. Wash. Acad. Sci 21 (1931) 486.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, Araracuara, "Cultivated by Witoto Indians. Leaves pulverized and smoked as hallucinogen. July 1985. *R. E. Schultes sine num.*

Sterile voucher specimens were collected. They were determined by Schultes as representing *Banisteriopsis Caapi,* an identification confirmed by William Anderson. Voucher specimens have been deposited in the Herbario Nacional de Colombia, in the Economic Herbarium of Oakes Ames, Harvard University and in the Herbarium of the University of Michigan.

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THE GENUS DIMERANDRA

EMLY S. SIEGERIST

For many years the genus Epidendrum was regarded as an enigmatic one, because of the excessively large numbers of heterogenous elements which have been indiscriminately assigned to it. It was not until the early years of the twentieth century that systematists gave a closer look at the various structures found within this great complex of some 1200 species. It was during such an examination in 1922 when Schlechter realized that the very old *Epidendrum stenopetalum* together with a few similar plants, indeed, do represent such a divergence in salient features from the type species of Epidendrum that they warrant their own recognition at the generic level. Thus, the genus Dimerandra was proposed in conjunction with a new species from Panama. Dimerandra initially had a very short span of life, because the American botanists quickly labeled Schlechter as a *bona fide* splitter. Perhaps, it is understandable that such an attitude should have developed. In a closely knit group of plants, even though the individuals may represent different species, to a casual onlooker they easily appear to be mere variants of one another. The basic principle of design of similarity in dissimilarity manifested in nature, however, does not depend upon whether one is being a splitter or lumper, but rather upon one's

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ability to recognize the very elements of diversity within a unified complex.

Schlechter must have been aware of the problem of this diversity within unity, but he fell short in giving the actual details as he perceived them to be present within the whole Epidendrum complex. Indeed, the general structure of the column, the peculiar, externally keeled, erect columnar ears or lobes which are the extension of the clinandrium, the totally hidden, persistent anther, are all characters not duplicated within the genus Epidendrum. Perhaps plants of Oerstedella can be considered to be somewhat analogous to Dimerandra in columnar structures in as much as both have a cryptic anther.

An examination of the constituent species of Dimerandra brought several interesting points to the foreground. *Epidendrum stenopetalum,* one of the original species assigned by Schlechter to the genus, is described from Jamaica, but the species is unknown in the West Indies. Unfortunately, the type specimen is no longer extant. Therefore, our information has to come from the published plate, t.3410, of the Botanical Magazine, which is part of the original protologue. This drawing, originally made from a living specimen grown in the Glasgow Botanic Garden, shows a perfectly rhombic lip; yet none of the collections which I have examined correspond to that configuration. Reichenbach, however, had seen the type before it disappeared and, as was his practice, he made a drawing of the flower. This drawing also shows a lip which I have not encountered among the numerous specimens examined. There is a remote possibility that my new *D. latipetala* from Nicaragua may represent the missing *D. stenopetala,* because vegetatively the plants are identical. The discrepancies, however, found in the morphology of the petals, lip and of the columnar ears, as far as the available informations are concerned, do not permit their union.

Dimerandra buenaventurae had a remarkable beginning. While Kraenzlin was monographing the genus Telipogon, in 1919, he found a single unattached flower in the Reichenbach Herbarium, which he, in spite of the unusual characters for a Telipogon, described as a new member of that genus. Garay in

1964 noted that it was an Epidendrum of the *E. stenopetalum* complex. This flower turned out to be not only distinct, but unique in the sense that the lip is completely free from the base of the column.

Perhaps one of the most intriguing puzzles comes from the pen of Reichenbach, when, in 1862, he listed *Isochilus elegans* Focke for the first time as a straight synonym of *Epidendrum stenopetalum.* Focke's material is kept at Utrecht, but all of their orchid specimens were on loan to Berlin during World War II, where they all succumbed during the fatal bombing when most of the Berlin herbarium was destroyed. *Isochilus elegans,* however, was not on loan because no one knew of its existence. Cogniaux did not cite it in his treatise on Brazilian orchids and Pulle did not in his Flora of Surinam, the country of origin of the species. The only person who must have seen the type beside Focke was Reichenbach. Incidentally, it should be mentioned here that Reichenbach had a very good rapport with Focke, having received from him either drawings or specimens or both of most of his species. *Isochilus elegans,* however, was not among them. Reichenbach's well-established practice of searching out types described by other botanists must have led him to Focke's collections in Utrecht. When I borrowed the holdings of the *Epidendrum stenopetalum* complex from Utrecht, there was only a single old sheet among them with the original old mounting due to the above-mentioned loss. This particular sheet has a label with *Epidendrum stenopetalum* written in Reichenbach's hand. This was attested by Dr. Garay, one of the few who can read Reichenbach's handwriting. An examination of this sheet, which fortunately still had a flower in perfect condition, has shown the characters completely matching and agreeing, including the measurements, with Focke's original description of *Isochilus elegans!* Therefore, it seems reasonable to consider it to be the long unrecognized holotype of *Isochilus elegans.* In as much as none of Focke's original material at Utrecht bears annotation labels in Focke's handwriting, this specimen, because of lack of an original annotation, did escape the fire at Berlin.

Due to the recent practices among botanists who fail to recognize the principle of diversity in similarity, every specimen in the Dimerandra complex came to be called *Dimerandra emarginata,* since the oldest basionym, published in 1818, was *Oncidium emarginatum.*

As was stated above, the plants of Dimerandra look quite different from the genus Epidendrum from which they were segregated. Vegetatively they are similar in appearance to another small group of plants originally described by Lindley as a distinct genus under the name of Gastropodium. Both groups have the more or less thickened stems which, especially in dried condition, become prominently sulcate or furrowed longitudinally. The flower structure of these two groups is, however, quite different. Ames, Schweinfurth and Hubbard in their monographic study of the genus Epidendrum in Central America placed *Epidendrum stenopetalum* together with those species which now comprise the genus Barkeria. Such a choice obviously served some practical solution in preparing a key for identification rather than expressing actual relationships. Attention must be called to one of the remarkable aspects of Dimerandra flowers, the random lobation occuring in the petals and the lip. This must be emphasized because I have seen lips of individual flowers where lobation may occur so symmetrically that the actual blade appears to be three-lobed, yet such a character may not be present on the second flower of the same plant.

Members of the genus occupy a considerable area of the American tropics, ranging from Mexico through Central America to northern and western South America, including the Orinoco and Amazonian basins. They are conspicuously absent from the West Indian Islands. Two species, *D. elegans* and *D. emarginata,* have the widest distribution; their pattern of variability in both vegetative and floral structures appear to be directly proportional to the geographic area they inhabit. The remaining species are rather restricted either in area or in frequency or both. *Dimerandra emarginata,* although described originally from Guayana, is most common in Central America, from Mexico to Chiriqui, in Panama. One of the most interesting character separations in the shape of the petals occurs on both sides of the isthmus of Panama. Plants with lanceolate-elliptic petals (*i.e.,* widest in the middle) occur in the Central American part of the range (formerly called *Epidendrum lamellatum* Lindl.), while those with obovate-oblanceolate petals (*i.e.,* widest in the upper third) are known from the South American mainland. This same character separation in the shape of the petals is manifested also in *D. elegans,* albeit the Central American range does not seem to extend beyond the Chiriqui mountains. For these restricted Panamaniam plants with obovate-oblanceolate petals, the name *D. isthmii* Schltr. was once proposed. It is quite probable that we are dealing here with a group of plants which currently undergo incipient divergence or speciation on both sides of the isthmus of Panama. Unfortunately the information so far available does not afford a more decisive conclusion. Another species closely related to this complex is *D. buenaventurae* which appears to be limited in distribution almost entirely to the Cauca and Magdalena valleys. *Dimerandra Rimbachii* and *D. tenuicaulis* are both endemics in western Ecuador, especially along the coastal lowlands. *Dimerandra carnosiflora* here described is the southernmost in distribution, known only from Peru and the adjacent Brazilian border areas. *Dimerandra latipetala* is unique in floral characters and is essentially limited to Nicaragua and Panama west of the isthmus.

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I am ever so grateful for the cooperation shown by the curators of the many herbaria who have so very kindly loaned the materials necessary for this study. My thanks also to the many institutions whose directors have given freely of their considerable knowledge to assist me in this endeavor.

An especial note of appreciation is due to Dr. Leslie A. Garay, Curator of the Oakes Ames Orchid Herbarium, for his many hours of patient assistance and his generous sharing of the herbarium's specimens as well as giving free access to his own private files. Without his expertise and unfailingly excellent advice, this paper would not have been possible.

Dimerandra Schltr. in Fedde, Rep. Beih. 17: 43, 1922.

Sepals similar, spreading; lateral sepals oblique; all more or less linear-lanceolate, acuminate. Petals spreading, more or less rhombic to elliptic, often along one side the margin lobulate; lip either free to base or laterally adnate basally to column, then with a cuneate-flabellate blade; disc under column with a callus of imbricating lamellae in three rows; on each side there is an additional callose ridge. Column short, somewhat arcuate, with two prominent lobes to the clinandrium, both of which are externally keeled. Anther incumbent, small, completely hidden within the lobes of the clinandrium, longitudinally septate. Pollinia four, compressed, inappendiculate. Ovary slender, pedicellate.

Epiphytic plants; roots flexuous, glabrous; stems caespitose, erect, fleshy, leafy throughout, completely covered with thin, imbricating leafsheaths, dry or old canes striate-sulcate; leaves subcoriaceous, oblong-linear to ligulate, sessile, articulate with leaf-sheaths; inflorescence terminal, 1–3, very short, 1-, 2-flowered; flowers showy.

LECTOTYPE: **Epidendrum Rimbachii** Schltr., *in hoc loco!*

Eight species distributed in Central America, from Mexico to Panama, in northern and western tropical South America, from the Guayanas to Peru, and along the edges of the Amazonian Hyalea.

KEY TO SPECIES

1. Flowers fleshy; petals broadly elliptic; fleshy ridges flanking calli forked; column-ears ovate-lanceolate, acuminate .... **D. carnosiflora**

1a. Flowers delicate in texture; petals rhombic to lanceolate; fleshy ridges flanking calli undivided; column-ears rectangular to transversely oblong 2

2. Lip from a broad base abruptly rhombic to obtrapeziform in outline, widest at or below the base 3

2a. Lip from a narrowly cuneate-unguiculate base obverse in outline, widest above the middle 4

3. Petals obovate-oblanceolate; lip rhombic to obscurely 3-lobed, lateral lobes rounded, midlobe terminal, transversely quadrate-oblong, truncate in front .... **D. stenopetala**

3a. Petals broadly rhombic; lip obtrapeziform, sinuously bilobed in front with a small apicule .... **D. latipetala**

4. Lip free to base, bilobed to retuse; callus without a central row of lamellae; anther with three horn-like protuberances .... **D. buenaventurae**

4a. Lip laterally adnate to base of column; entire or subtruncate to somewhat retuse; callus with a central row of lamellae; anther without horns 5

5. Lateral rows of callus fleshy, entire, keel-like, terminating in a few imbricating lamellae 6

5a. Lateral rows of callus not keel-like, but composed of numerous imbricating lamellae almost to base 7

6. Leaves linear-oblong, grass-like, 3–4 mm. wide; flowers thin, diaphanous; floral segments more than 10 mm. long; lateral sepals with a prominent, horn-like mucro; anterior margin of lip serrate-denticulate .... **D. Rimbachii**

6a. Leaves linear-lanceolate, 6–7 mm. wide; flowers thin but firm in texture, not diaphanous; floral segments less than 10 mm. long; lateral sepals without a mucro; anterior margin of lip entire .... **D. tenuicaulis**

7. Three rows of callus united into transverse plates at apex in front of which there are a few, free-standing lamellae; columnar ears transversely oblong, acute to obtuse .... **D. elegans**

7a. Three rows of callus free from one another at apex, although they may be convergent at tip without accessory lamellae; columnar ears subquadrate to rounded, often with cellular margins .... **D. emarginata**

Dimerandra buenaventurae (Krzl.) Siegerist, *comb. nov.*

Basionym: *Telipogon buenaventurae* Krzl. in Ann. Naturhist. Hofmus. Wien 33: 35, 1919.

TYPE: Colombia. Dept. Valle, near Buenaventura. Klaboch *s.n.* (W!)

Epiphytic, erect plants up to 40 cm. tall; roots fleshy, rather coarse, branching, flexuous, glabrous; stems from a bulbous base suberect to arcuate, somewhat flexuous, leafy; leaves alternate, linear-lanceolate, obtuse or somewhat unequally bilobate apex, up to 10 cm. long, 1.2 cm. wide, usually smaller; inflorescences fasciculate, produced in succession, short, few-flowered; bracts ovate-cucullate, acute, up to 4 mm. long; flowers large; dorsal sepal ovate-lanceolate, acuminate, up to 1.8 cm. long, 5 mm. wide; lateral sepals obliquely ovate-lanceolate, acuminate, up to 1.8 cm. long, 6 mm. wide; petals from a cuneate base, subrhombic, obovate-oblanceolate in outline, acute to acuminate, up to 2 cm. long, 1.2 cm. wide; lip from a cuneate base, obovate, subtruncate to retuse at apex, rarely obcordate; callus 3-parted, lamellate, without a central row of lamellae, basally united into a fleshy ridge; whole lip up to 2 cm. long, 1.3 cm. wide; column short, 4 mm. long, with a pair of obliquely and transversely quadrate-oblong ears; pedicellate ovary cylindric, up to 4 cm. long.

DISTRIBUTION: **Colombia.** DEPT. VALLE; Zarzal. Pennell, Killip & Hagen 8400 (AMES!, NY!, US!); Cuatrecasas 22094 (AMES!, F!). Cali. Lehmann 880 (G!); Lehmann *s.n.* (W!). La Paila. Holton *s.n.* (NY!) Las Juntas. Lehmann 129 (W!). Timbe. von Sneidern 1114 (F! NY!) Victoria. André *s.n.* (NY!) Pance. Navarette 12 (AMES!). — DEPT. TOLIMA; Dolores forests. Lehmann 7603 (AMES!, L!, NY!). — DEPT. NORTE DE SANTANDER; Ocaña. Bruchmueller *s.n.* (W!). — DEPT. MAGDELENA; Quebrada Sororia. Haught 3617 (AMES!). Santander. Gentry & Renteria 19991 (SEL!). — DEPT. SUR DE SANTANDER; Magdalena Valley, Sogamoso. Haught 1393 (AMES!). — DEPT. CESAR; Rincon Hondo. C, Allen 548 (MO!).

FIELD CHECK: Lip free from column; callus without a central row of imbricating lamellae.

Dimerandra carnosiflora Siegerist, *sp. nov.*

TYPE: Peru. Prov. Bagua; Dept. Amazonas. Hutchinson 1542 (AMES!) Holotype. (F!, UC!) Isotypes.

Plantae epiphyticae, erectae; caulibus suberectis, arcuatis, flexuosis; foliis linearibus, apice paululo inaequaliter rotundatis; inflorescentiis fasciculatis, ad 5, paucifloris; bracteis ovato-lanceolatis, acuminatis, cymbiformibus; floribus carnosis; sepalo postico lanceolato-elliptico, acuminato; sepalis lateralibus ovato-lanceolatis, subfalcatis, acuminatis; petalis late ellipticis, acutis; labello e cuneata basi subquadrato-spathulato, truncato, disco multilamellato in 3 lineas, utrinque callo bicruri donato; columnae alis ovato-lanceoloatis, acuminatis.

Epiphytic, erect plants, up to 25 cm. tall; roots rather slender, glabrous; stems suberect, arcuate, flexuous, completely enclosed in tightfitting, imbricating sheaths; leaves linear, rounded at the somewhat unequally lobulate apex, up to 8 cm. long, 6 mm. wide; inflorescences fasciculate, 3 to 5, short, up to 1.5 cm. long, few flowered; bracts ovate-lanceolate, cymbiform, acuminate, up to 3 mm. long; flowers fleshy with spreading segments; dorsal sepal narrowly elliptic-lanceolate, acuminate, 17 mm. long, 5 mm. wide; lateral sepals obliquely ovate-lanceolate, subfalcate, acuminate, up to 17 mm. long, 5 mm. wide; petals from a somewhat cuneate base broadly elliptic, acute, up to 18 mm. long, 10 mm. wide; lip from a cuneate base subquadrate-spathulate, truncate, occasionally lobulate; callus multilamellate in 3 rows, with an additional forked ridge on each side, up to 18 mm. long, 12 mm. wide; column 7 mm. high with ovate-lanceolate, acuminate lobes to the clinandrium; pedicellate ovary up to 4 cm. long.

DISTRIBUTION: **Peru.** See above. — **Brazil.** AMAZONAS; Boca do Acre, Rios Purus & Acre. Prance *et al.* 2581 (US!).

FIELD CHECK: Flowers fleshy; lateral sepals falcate; petals broadly elliptic; lateral ridges forked.

Dimerandra elegans (Focke) Siegerist, *comb. nov.*

Basionym: *Isochilus elegans* Focke in Tidjdschr. Naturk. Vetschr. 4: 68, 1851.

TYPE: Surinam. Paramaribo. Focke *s.n.* (U!) Teste Reichenbach.

Synonym: *Dimerandra isthmi* Schltr. in Fedde, Rep. Beih. 17: 44, 1922.

TYPE: Panama. Canal Zone. Hills near Panama City. Powell 17 (AMES!) Holotype. (MO!) Isotype.

Dimerandra major Schltr. in Fedde, Rep. Beih. 27: 136, 1924.

TYPE. Colombia. Dept. Cundinamarca. Río Pescado, Cordillera Oriental. A. Schultze 29 (+B).

Plants epiphytic, up to 40 cm. tall; roots fleshy, flexuous, glabrous; stems approximate, erect, flexuous, leafy; leaves subcoriaceous, alternate, linear-oblong to oblong-ligulate, obtusely bilobed at apex, articulate with leaf sheaths, up to 11 cm. long, 1 cm. wide, commonly smaller; inflorescences short, few-flowered; bracts ovate-cucullate, subacuminate, up to 3 mm. long; flowers showy, with spreading segments; dorsal sepal narrowly ovate-lanceolate to oblong-elliptic, acute to subacuminate, up to 19 mm. long, 6 mm. wide; lateral sepals obliquely ovate-lanceolate, acuminate, up to 19 mm. long, 6 mm. wide; petals from a cuneate base, obovate-oblanceolate to obliquely lanceolate-elliptic, acute to subacuminate, up to 20 mm. long, 8 mm. wide; lip from a cuneate base obovate-spathulate to suborbicular, subtruncate to retuse in front or rarely more or less bilobed with a mucro; disc callose with 3 rows of lamellae united into transverse plates at apex, and in front of it with a few free-standing, transverse additional lamellae; whole lip up to 20 mm. long, 12 mm. wide; column short, up to 6 mm. long, with large, transversely oblong acute to obtuse ears; pedicellate ovary cylindric, up to 4 cm. long.

DISTRIBUTION: **Panama**. BOCAS DEL TORO; Water Valley. von Wedel 765 (AMES!, MO!). — PROV. CHIRIQUI; near David. Maxon 4915 (AMES!, US!). — PROV. VERAGUAS; Liesner 840 (MO!); Gentry 3037 (MO!); Powell 3419 (AMES!). — CANAL ZONE; Near Summit. Standley 29694 (US!). — BARROW COLORADO ISLAND; Croat 8156 (MO!, NY!), 4682 (MO!, NY!), 7054 (MO!), 7369 (MO!), 8183 (MO!), 14970 (MO!); Standley 31498 (US!); Shattuck 221 (MO!, US!). Gamboa. Pittier 2605 (US!). Sabanas. N. of Panama City. Bro. Paul 554 (US!). Hills E. of city. Powell 3437 (AMES!). Las Cruces Trail between Ft. Clayton & Corozal. Standley 29101 (AMES!, US!); Duke 4783 (MO!). — PROV. PANAMA; Chepo. Pittier 4562 (US!). E. of Río Tecumen. Standley 26610 (US!). — PROV. DARIEN; Río Tuira. Duke 6521 (MO!), 6524 (MO!), 14588 (MO!). Near Santa Fe. Duke 8820 (MO!). Río Paya. Duke & Kirkbride 14072 (MO!) **Colombia.** DEPT. MAGDALENA; Manaure. Foster & Smith 1595 (AMES!). — DEPT. ANTIOQUIA; Atrato & Truando 8 (NY!) — DEPT. META; Salta Angustora. Garcia-Barriga & Mejía 17014 (AMES!); Cabuyaro. Cuatrecasas 3607 (US!); Quebrada Canabrava. Killip 34465 (AMES!, US!). Los Llanos, Río Meta, La Perra. Cuatrecasas 4305 (US!). **Trinidad.** Agua Santa. Broadway 2347 (AMES!); St. Clair Experiment Station. Broadway *s.n.* (AMES!). **Venezuela.** PROV. YARACUY; near Guama. Pittier 11172 (AMES!, US!). — PROV. MERIDA; La Azulita. Humbert 26663 (P!); Linden 184 (G!): 710 (K!, W!). — PROV. ZULIA; Perija. Bruijn 1243 (US!); Jangous 10200 (F!); Steyermark & Fernandez 99654 (AMES!). — DIST. FEDERAL; Caracas. Wagener 60 (W!). — EDO. BOLIVAR; 55 km. N.E. Ciudad Piar. Liesner & Gonzales 11235 (MO!). — DELTA AMACURO; Aristeguieta 4038 (NY!); Steyermark 87714 (NY!). **Brazil.** AMAZONAS; Kuhlmann *s.n.* (AMES!). — BAHIA; Blanchet 1735 (F!, G!). **Surinam.** Paramaribo. Samuels 83 (AMES!, UC!); Samuels *s.n.* (US!); Splitgerger 48 (W!), 372 (L!, W!); Wullschlaegel 569 (US!). 12 km. E. of Paramaribo. Lelydorp & Hekking 793 (NY!, US!). Lobinsavanna inter Zanderij I & Hannover. van Donselaar 242

(U!); Lanjouw & Lindemann 136 (U!). — DIST. MAROWIJNE; seashore. Tenuissen 1072 (U!). — DIST. BROKOPONDO; Sara Creek. van Donselaar 2132 (U!), 3249 (U!). Surinam River. van Donselaar 2877 (U!); Schulz 7240 (U!). Raleigh Falls; upper Coppename River. Mannega 356 (U!). **French Guiana.** Cayenne. Broadway 227 (AMES!, NY!); Richard *s.n.* (W!). **British Guiana.** POMEROON DIST.; Moruka River. de la Cruz 1154 (NY!, US!). Essequibo River. Gleason 892 (NY!).

FIELD CHECK: 3 rows of lamellae united into transverse plates at apex with a few free-standing plates in front of it. Columnar lobes are transversely oblong, acute to obtuse.

OBSERVATION: The following illustrations belong to this species: Venezuelan Orchids Illustrated 3: 116, 1965; Orchids of Venezuela, Field Guide, Pl. 167, 1979; Foldats in Lasser, Fl. Venez. 15(3): 403, 1970; Orquidea (Mex.) 8(2): 97, 1978.

Dimerandra emarginata (Meyer) Hoehne in Bolet. Agric. S. Paulo 34a: 618, 1933.

Basionym: *Oncidium emarginatum* Meyer in Prim. Fl. Essequ. 259, 1818.

TYPE: British Guiana. Along the River Essequebo. Meyer 2631 (GOET!).

Synonym: *Epidendrum lamellatum* Westc. ex Lindl. in Bot. Reg. 29: misc. 46, 1843.

Dimerandra lamellata (Westc. ex Lind.) Siegerist ex Hamer in Icon. Pl. Trop. pt. 13: t. 1213, 1985.

TYPE: Country of origin unknown, presumed to be Honduras. Barker *s.n.* (K-Lindl.!)

Epiphytic, caespitose plants up to 40 cm. tall; roots flexuous, branching, glabrous; Stems cylindrical from a bulbous base, suberect to arcuate, moderately fractiflex, loosely leafy, especially towards the apex; leaves alternate, articulate with leaf sheaths, linear-oblong, obtuse, obliquely retuse at apex, up to 11 cm. long, 1 cm. wide; inflorescences short, produced in succession, few-flowered; bracts ovate-cucullate, acute, much shorter than the subtending flowers, up to 5 mm. long; flowers conspicuous with spreading segments; dorsal sepal ovate-lanceolate to narrowly elliptic, acute to acuminate, up to 18 mm. long, 6 mm. wide; lateral sepals obliquely ovate-lanceolate, acuminate, up to 18 mm. long, 6 mm. wide; petals from a cuneate base, obovate-oblanceolate to subrhombic-elliptic, acute, up to 18 mm. long, 10 mm. wide; lip basally adnate to column, from a cuneate base obovate-spathulate, apiculate in front; disc with 3 free rows of imbricating lamellae without accessory tubercules, central ridge half as long and entire, whole lip up to 20 mm. long, 15 mm. wide;

column cylindric, slightly arcuate, terminated by 2 subquadrate ears with rounded angles, often with prominent cellular margins, up to 6 mm. long; pedicellate ovary cylindric, up to 4 cm. long.

DISTRIBUTION: **Mexico.** PROV. OAXACA; Mogoñé. Nagel 5718 (AMES!). — PROV. VERA CRUZ; region of Minatitlan. Richards 3828 (AMES!); Sessé & Mociño *s.n.* (W!). **Guatemala.** PROV. PETEN; La Libertad. Lundell 2323 (AMES!). **Belize.** Spanish Creek. Lundell 3902 (AMES!). Punta Gorda. Catling & Brownell 19.2 (AMES!). — STANN CREEK DIST.; Stann Creek Valley. Gentle 2743 (AMES!). — EL CAYO DIST.; Vaca. Gentle 2541 (AMES!). — TOLEDO DIST.; near San Antonio. Gentle 5485 (AMES!, US!). **Honduras,** DEPT. ATLÁNTIDA; La Fragua. Ames *s.n.* (AMES!); Standley 55725 (AMES!). Tela. Standley 55246 (AMES!); Erskine *s.n.* (AMES!). **El Salvador.** Near Sihuapilapa. Avila 304 (SEL!). **Nicaragua.** DEPT. ZELAYA; near Río Prinzapolka, Stevens 8267 (AMES!, MO!). San José del Hormiguero. Stevens 7126 (SEL!), 18727 (SEL!). Cerro Waylawas. Pipoly 4500 (SEL!); Stevens 8768 (MO!). Road between Siuna & Matagalpa. Stevens 7473 (MO!). — DEPT. ULI ABAJO; Vincelli 352 (MO!). — DEPT. NUEVA SEGOVIA; El Jicaro. Moreno 6943 (MO!). — DEPT. CHONTALES; between Acoyapa & Río Oyate. Stevens 19119 (SEL!). Río Micca. Heller 7824A (specimen) (SEL!). — DEPT. DE RIVAS; Sandino 533 (MO!). — DEPT. JINOTEGA; Araquistain & Castro 1973 (MO!); Araquistain & Moreno 1567 MO!). — DEPT. DE BOACO; Stevens 5847 (SEL!). **Costa Rica.** Without locality. Pittier & Tonduz 18 (US!), Endres 633 (W!). **British Guiana.** See above. **Surinam.** Cottica River near Moengo. Lanjouw 479 (U!). **Trinidad.** Sta. Cruz. Broadway 2925 (AMES!). Without locality. Broadway *s.n.* (AMES!, G!, NY!, US!). **Venezuela.** DELTA AMACURE; Meyer 3558 (U!). Rio Torre, N. of El Palmar. Steyermark 87842 (NY!).

FIELD CHECK: 3 rows of lamellae are free from one another at the tips and without accessory tubercles in front. Columnar lobes often with cellular margins.

OBSERVATION: The following illustrations represent this species: Hamer, Orch. El. Salvador 1: 263, 1974. Hamer in Icon. Pl. Trop. pt. 11: t.1013, 1984, only the dissected floral details. Hamer in Icon. Pl. Trop. pt. 3, t.1213, 1985.

Dimerandra latipetala Siegerist, *sp. nov.*

TYPE: Nicaragua. Prov. Chontales; Santo Tomas. Atwood & Neill 7030 (AMES!) Holotype. (SEL!, UC!) Isotypes.

Plantae epiphyticae, erectae; radicibus filiformibus, flexuosis, glabris; caulibus erectis, cylindraceis, fractiflexis, foliosis; foliis lanceolatis, rigidis, apice oblique bilobis; inflorescentiis succedaneis, abbreviatis, paucifloris; floribus speciosis, patentibus; sepalo postico ovato-lanceolato, acuto; sepalis lateralibus ovato-lanceolatis, acutis vel acuminatis; petalis e cuneata basi late rhombeis, acutis; labello e cuneata basi obtrapezoideo, antice bilobo, disco multilamellato, in lineis ternis valde approximatis producto; columna cylindrica, apice bialata; ovario cylindrico, longe pedicellato.

Epiphytic, caespitose plants, up to 20 cm. tall; roots filiform, flexuous, glabrous; stems approximate, cylindrical, from a bulbous base erect, sinuously fractiflex, leafy; leaves articulate with the tightly appressed sheaths, lanceolate, rigid, conduplicate at base, obliquely bilobed at apex with rounded lobes, up to 8 cm. long, 1 cm. wide; inflorescences produced in succession, very short, few-flowered; bracts ovate-cucullate, concave, acute, up to 3 mm. long; flowers produced in succession, 1–3, showy with spreading segments, rose-magenta in color; dorsal sepal ovate-lanceolate, acute to acuminate, up to 13 mm. long, 5.2 mm. wide; lateral sepals obliquely ovate-lanceolate to elliptic-lanceolate, acute to subacuminate, up to 14 mm. long, 5 mm. wide; petals from a cuneate base broadly rhombic, acute with rounded angles on each side, up to 13 mm. long, 9 mm. wide; lip slightly adnate to base of column, from a cuneate base obtrapezoid with rounded angles, distinctly bilobed in front provided with a short central apicule; disc before the callus prominently cochleate; callus consists of 3 rows of tightly approximate lamellae confluent in front, on each side with an additional tuberculate ridge; whole lip up to 13 mm. long, 13 mm. wide; column cylindric terminated by 2 erect, quadrate ears pointed in front, rounded dorsally, up to 6 mm. long; pedicellate ovary cylindric, up to 3.5 cm. long.

DISTRIBUTION: **Guatemala.** DEPT. IZABEL; Río Dulce. Hamer A305! Photograph. **Nicaragua.** PROV. CHONTALES; Río Micca. Heller 7824B (drawing) (SEL!). **Costa Rica.** PROV. SAN JOSÉ; Puriscal. Alfaro 221 (US!). — PROV. GUANACASTE; Tilarán. Standley & Valerio 44214 (AMES!). **Panama.** PROV. DE HERRERA; Las Minas. Stern, Eyde & Ayensu 1791 (MO!, US!). Between Canal Zone & Colón. Standley 30302 (AMES!, US!). — PROV. PANAMA; E. of Río Tecumen. Standley 30448 (AMES!, US!). Chagres. Fendler 332 (AMES!, MO!). — CANAL ZONE; near Summit. Standley 29501 (US!). — PROV. VERAGUAS; near Bigis and San Juan. Dodge, Steyermark & Allen 16586 (AMES!). **Colombia,** DEPT. ANTIOQUIA. Escobar s.n.! Photograph.

FIELD CHECK: Lip obtrapeziform, *i.e.* wider near base than towards apex. Petals broadly rhombic.

OBSERVATION: Color illustration in American Orchid Society Bulletin 38: 67, 1969, published as *Epidendrum stenopetalum* Hook. belongs here. Hamer in Icon. Pl. Trop. pt. 13: t. 1013A, 1985.

Dimerandra Rimbachii (Schltr.) Schltr. in Fedde, Rep. Beih. 17: 44, 1922.

Basionym: *Epidendrum Rimbachii* Schltr. in Fedde, Rep. Beih. 8: 167, 1921.

TYPE: Ecuador. prov. Guayas; near Ventamas. Rimbach 2 (AMES!).

Epiphytic, slender plants up to 35 cm. tall; roots filiform, flexuous, glabrous; stems erect, slightly flexuous, leafy above; leaves alternate, oblong-linear, grass-like, obtuse at the obscurely bilobed or retuse at apex, basally articulate with leaf sheaths, up to 11–13 cm. long, 3–4 mm. wide; inflorescence terminal, very short, 1-, 2-flowered; bracts ovate-cucullate, acute, up to 2 mm. long; flowers small, thin, diaphanous, pale rose to lavender, with spreading segments; dorsal sepal narrowly elliptic, acute, up to 11 mm. long, 3.5 mm. wide; lateral sepals obliquely elliptic with a conduplicate, recurved apex, dorsally provided with a prominent, horn-like mucro, up to 11 mm. long, 4 mm. wide; petals oblanceolate-elliptic to subrhombic, acute, up to 13 mm. long, 5 mm. wide; lip from a cuneate base, obovate-flabellate, subserrate-denticulate in front, shallowly emarginate at the apiculate apex; callus at base consists of 3 rows of fleshy keel-like ridges free from one another, terminated by a few transverse lamellae; whole lip up to 13 mm. long, 11 mm. wide; column cylindric, up to 3 mm. long, prominently winged in front, terminated by subrotund apiculate ears which are 1 mm. long, 1 mm. wide; pedicellate ovary cylindric, up to 2 cm. long.

DISTRIBUTION: **Ecuador.** PROV. GUAYAS; 12 km. from Guayaquil. Gilmartin 686 (US!), 715 (US!). — PROV. LOS RÍOS; Montalvo. Holm-Neilsen *et al.* 2597 (AMES!). Nuevo Zapotal. MacBryde 418 (AMES!, MO!, SEL!).

FIELD CHECK: Leaves linear, grass-like. Flowers thin, diaphanous. Lateral sepals with a prominent, horn-like mucro. Lip serrate-denticulate along anterior margins.

Dimerandra stenopetala (Hook.) Schltr. in Fedde, Rep. Beih. 17: 44, 1922.

Basionym: *Epidendrum stenopetalum* Hook. in Bot. Mag 62: t.3410, 1835.

Synonym: *Caularthron umbellatum* Raf., Fl. Tellur. 2: 41, 1837.

TYPE: Cultivated in Glasgow Botanical Garden. No preserved specimen known to exist today.

Plants epiphytic, erect, up to 30 cm. tall; roots fleshy, flexuous, glabrous; stems approximate, from a bulbous base suberect, slightly flexuous, leafy above; leaves alternate, linear-oblong, obtuse at the obliquely bilobed apex, up to 7 cm. long, 1 cm. wide; inflorescences fasciculate, very short, few-flowered; bracts ovate-cucullate, very much shorter than the subtending pedicels; flowers rose-colored, showy with spreading segments; dorsal sepal ovate-lanceolate, acuminate, up to 14 mm. long, 4 mm. wide; lateral sepals obliquely ovate-lanceolate, acuminate, up to 15 mm. long, 5 mm. wide; lip from a cuneate base, trapeziform-elliptic in living condition, obtuse to rounded in front, widest near middle; in dry condition from a cuneate base, obtrapeziform, 3-lobed, lateral lobes rounded, terminal lobe transversely quadrate-oblong, subtruncate in front; disc at base with a few transverse lamellae, whole lip up to 15 mm. long, 10 mm. wide; column short, terminated by 2, rounded, apiculate ears, up to 4 mm. long; pedicellate ovary cylindrical, arcuate, up to 2.5 cm. long.

DISTRIBUTION: Native country unknown; originally reported from Jamaica, but the species is not known on any of the West Indian islands.

FIELD CHECK: Lip rhombic to obtrapeziform in outline, *i.e.,* wider near the base than near the apex. Petals obovate-oblanceolate.

OBSERVATION: Since the type specimen cannot be located, the description is drawn from the original publication and plate in the Botanical Magazine as well as a drawing of the whole flower (reproduced here) in the Reichenbach Herbarium. This latter drawing had been prepared by Reichenbach from the type.

Dimerandra tenuicaulis Rchb.f.) Siegerist, *comb. nov. et stat. nov.*

Basionym: *Epidendrum stenopetalum var. tenuicaule* Rchb.f. in Otia Bot. Hamb. 1: 12, 1878.

TYPE: Ecuador. Prov. Guayas; Sabanella near Guayaquil. Lehmann 82 (W!).

Epiphytic, erect or ascending plants, up to 40 cm. tall; roots fleshy, somewhat flexuous, glabrous. Stems slightly flexuous, sulcate, the upper two-thirds laxly leaved; leaves distichous, linear-lanceolate, somewhat unequally rounded at bilobed apex, basally articulate with tightly appressed leaf-sheaths, up to 8–12 cm. long, 5–7 mm. wide; inflorescence terminal, 1–3, very short, rarely more than one-flowered; bracts ovate-lanceolate, acute, rather concave, up to 3 mm. long; flowers small, similar to *D. Rimbachii,* but coarser in texture and not diaphanous, deep rose to kermesine in color; dorsal sepal narrowly elliptic, acute to subacuminate, up to 9 mm. long, 3.5 mm. wide; lateral sepals similar to dorsal sepal, but oblique, obscurely keeled, without a mucro; petals from a cuneate base obovate-oblanceolate, acute to subacuminate, up to 9.5 mm. long, 4 mm. wide; lip from a cuneate base suborbicular-spathulate, rounded in front with entire margins; callus at base formed by 3 approximate fleshy ridges terminating in a few fleshy lamellae; whole lip up to 10 mm. long, 7-8 mm. wide; column cylindric with subrotund ears to the clinandrium, up to 5 mm. long; pedicellate ovary up to 2 cm. long.

DISTRIBUTION: **Ecuador.** PROV. GUAYAS; Km. 28 on road Guayaquil-Quevedo, alt. 30 m. Dodson 52 (SEL!). Near Guayaquil. Strobel *s.n.* Introduced and cultivated in Montreal Botanic Garden 2822-54! — PROV. LOS RÍOS; Km. 20 on road Babahoyo-Guaranda. Dodson 55 (MO!, SEL!). Jauneche Forest, Canton Vinces. Dodson, Gentry & Valverde 8737 (MO!, SEL!). Santo Domingo. Dodson 5630 (SEL!) — PROV. ESMERALDAS; Santo Domingo-Esmeraldas. Dodson *et al.* 10421 (SEL!). 18 km SW. of Esmeralda on Muisne-Esmeralda Road. Sauleda *et al.* 3831 (SEL!).

FIELD CHECK: Leaves linear-lanceolate, not grass-like. Flowers not diaphanous. Lateral sepals without a mucronate tip. Lip with an entire margin in front.

PLATE 33

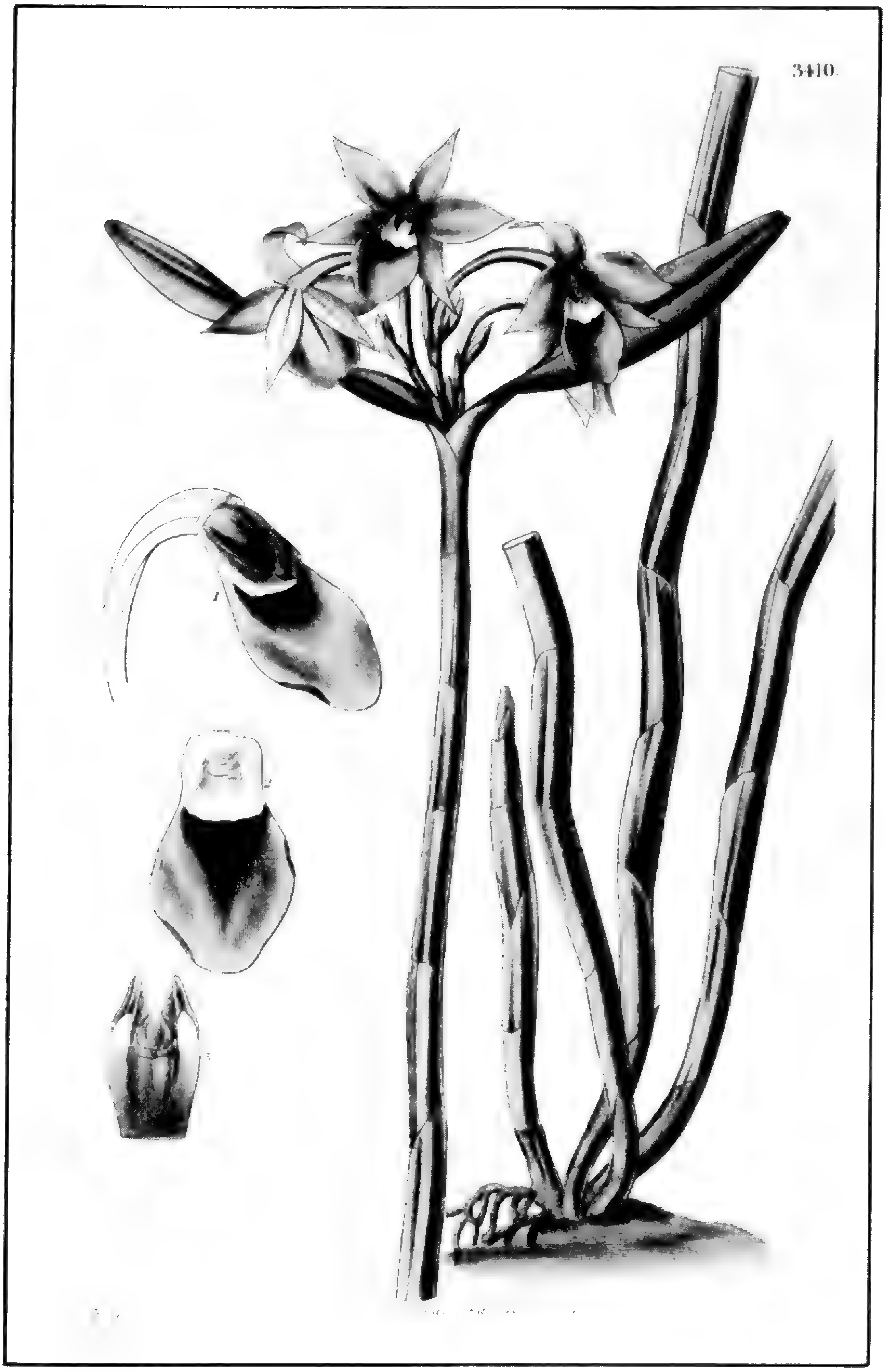

Plate 33. *Dimerandra stenopetala* (Hook.) Schltr.

PLATE 34

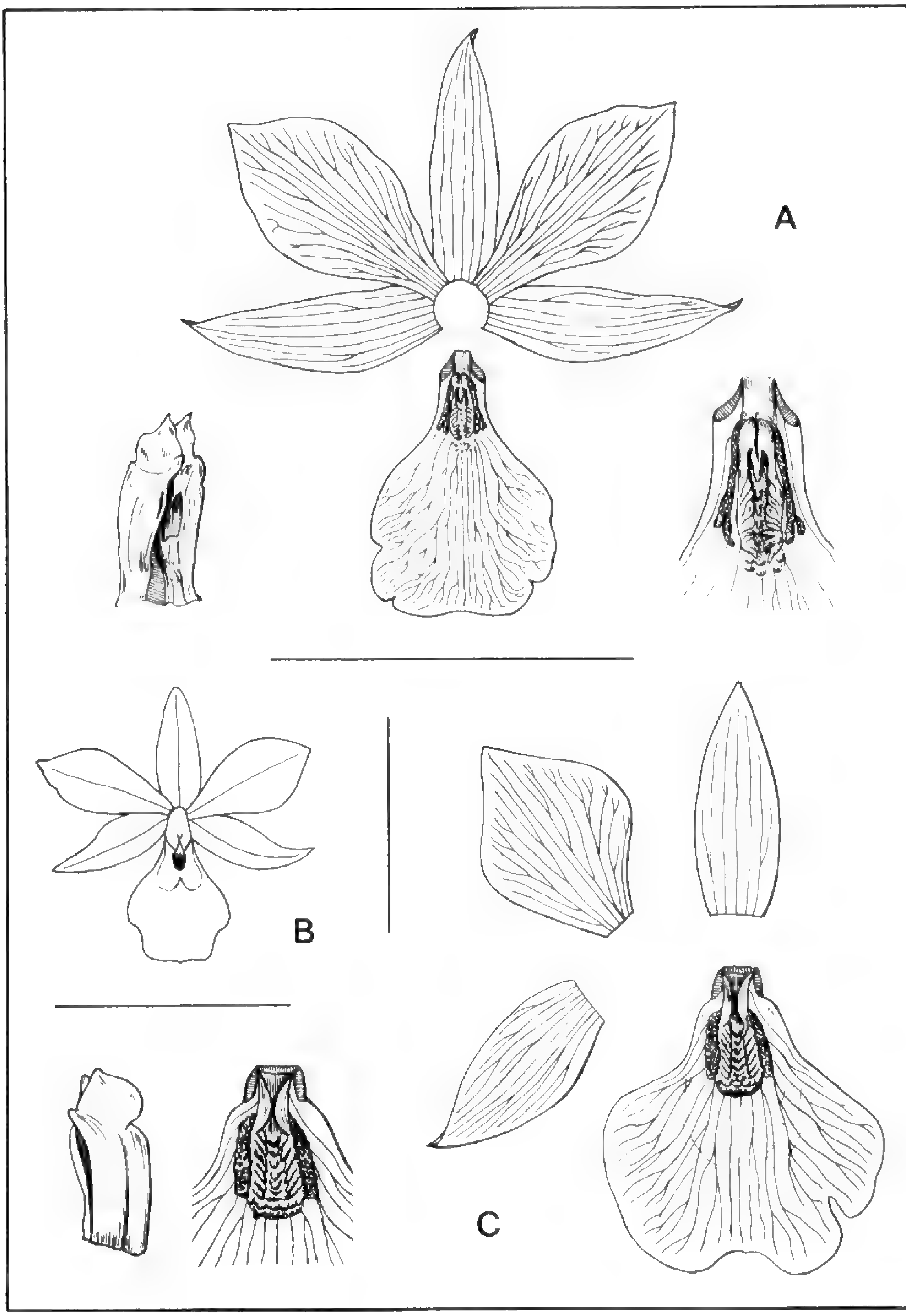

Plate 34. *A. Dimerandra carnosiflora* Siegerist. Type. B. *D. stenopetala* (Hook.) Schltr. Type, drawn by Reichenbach fil. C. *D. latipetala* Siegerist. Type.

PLATE 35

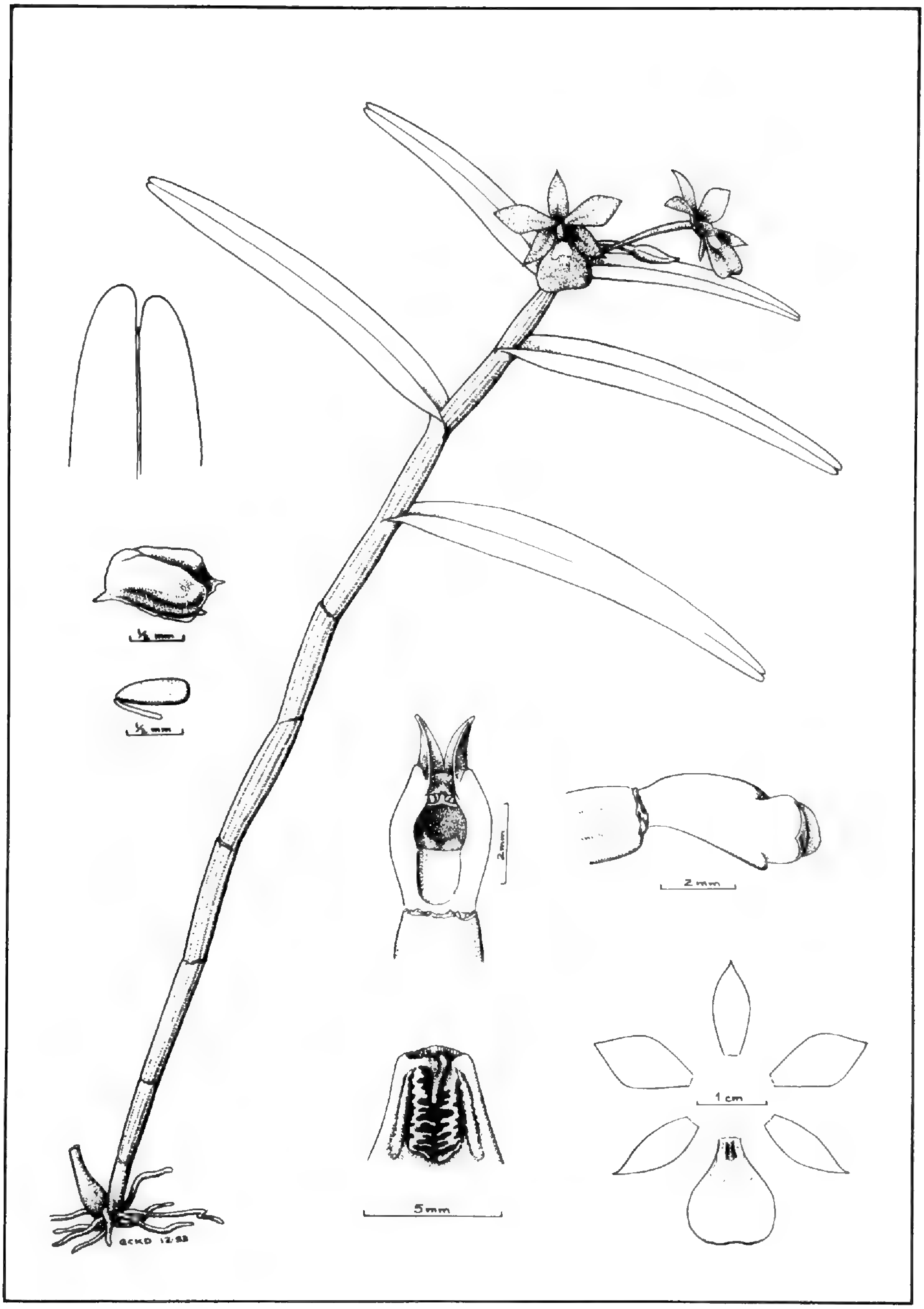

Plate 35. *Dimerandra buenaventurae* (Krzl.) Siegerist.

PLATE 36

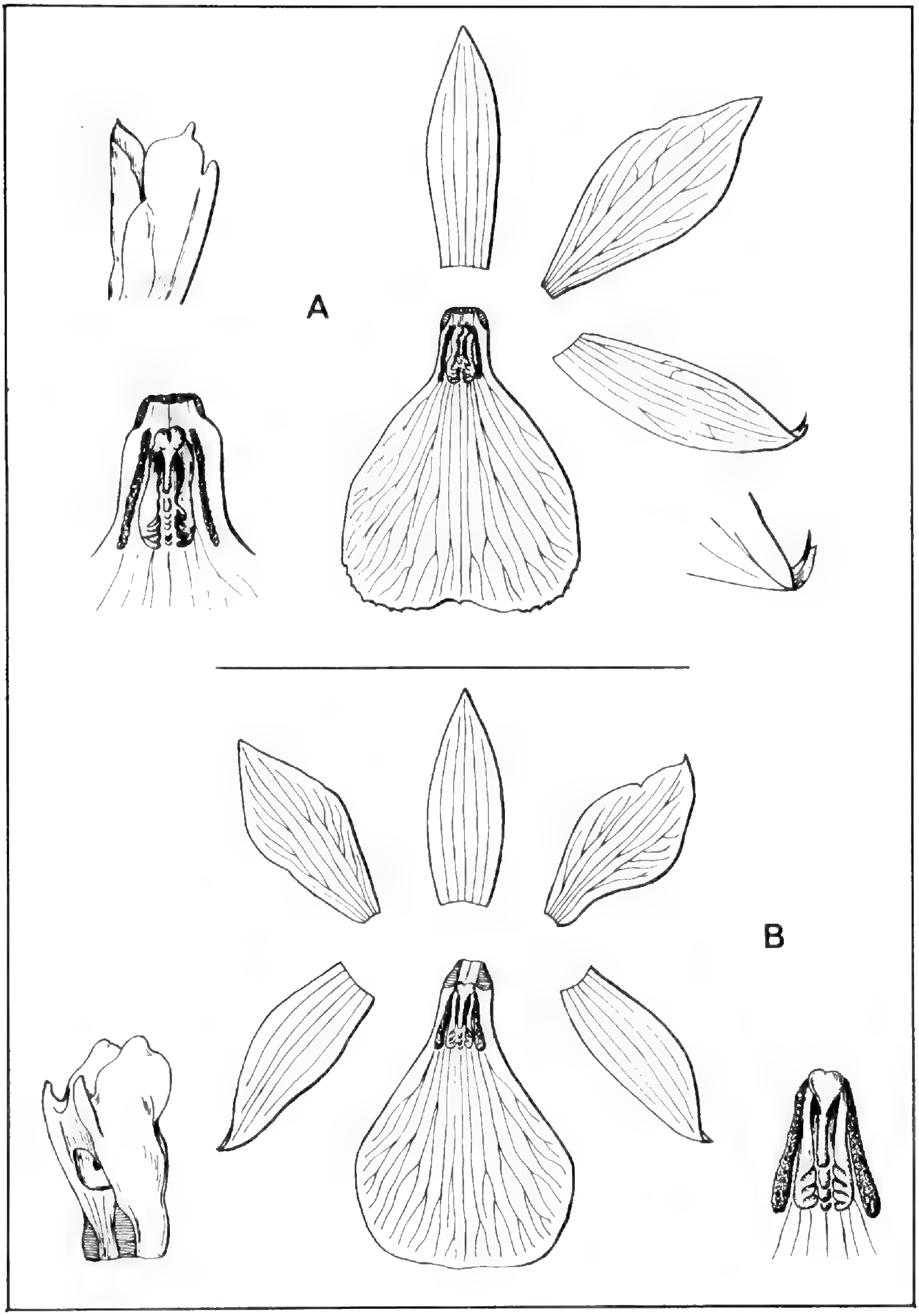

Plate 36. A. *Dimerandra Rimbachii* (Schltr.) Schltr. Type. B. *D. tenuicaulis* (Rchb. f.) Siegerist, drawings are based on Dodson 52.

PLATE 37

Plate 37. A. *Epidendrum stenopetalum* var. *tenuicaule* Rchb. f. Type. B. *E. lamellatum* Westc. ex Lindl. Type.

PLATE 38

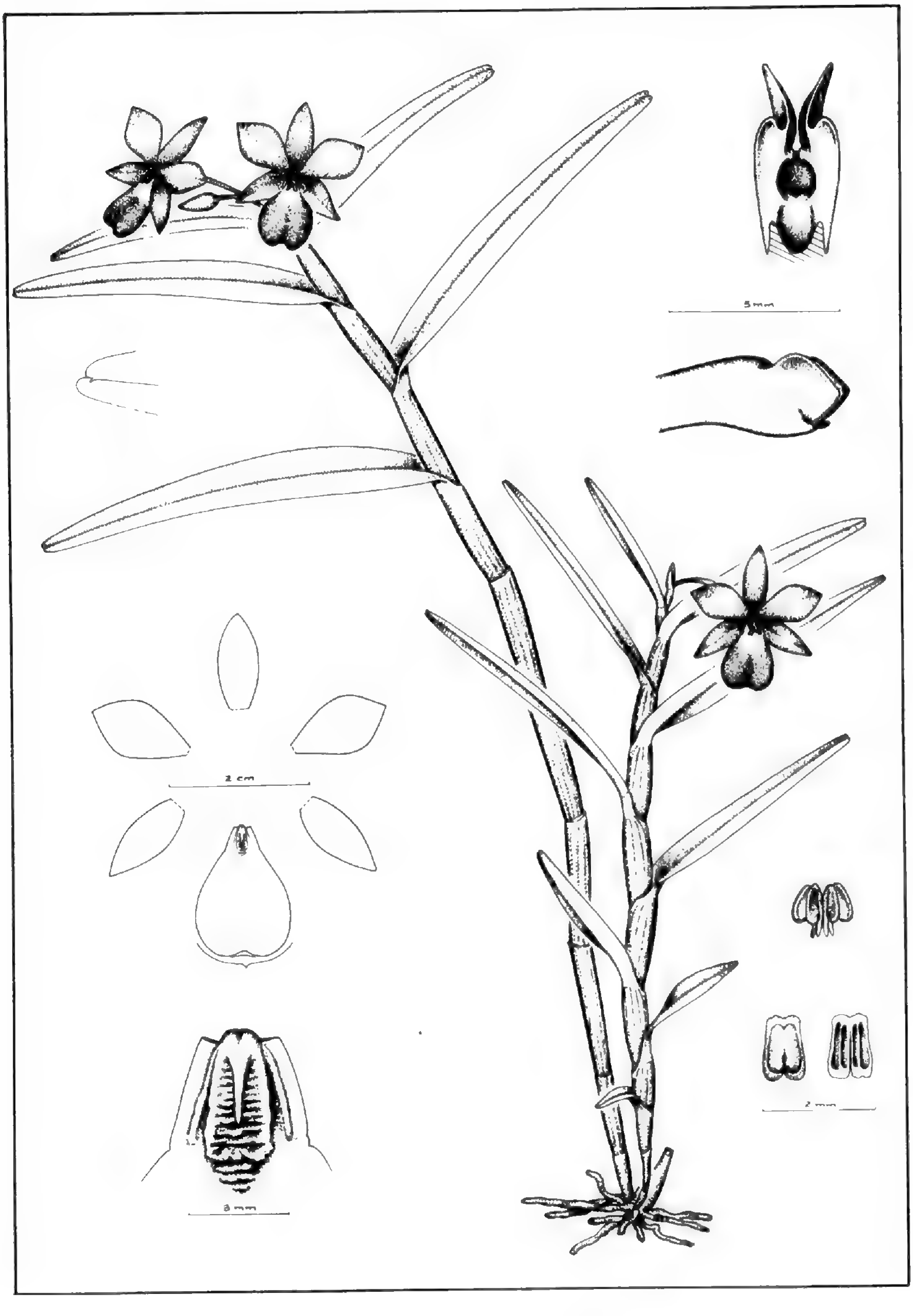

Plate 38. *Dimerandra elegans* (Focke) Siegerist.

PLATE 39

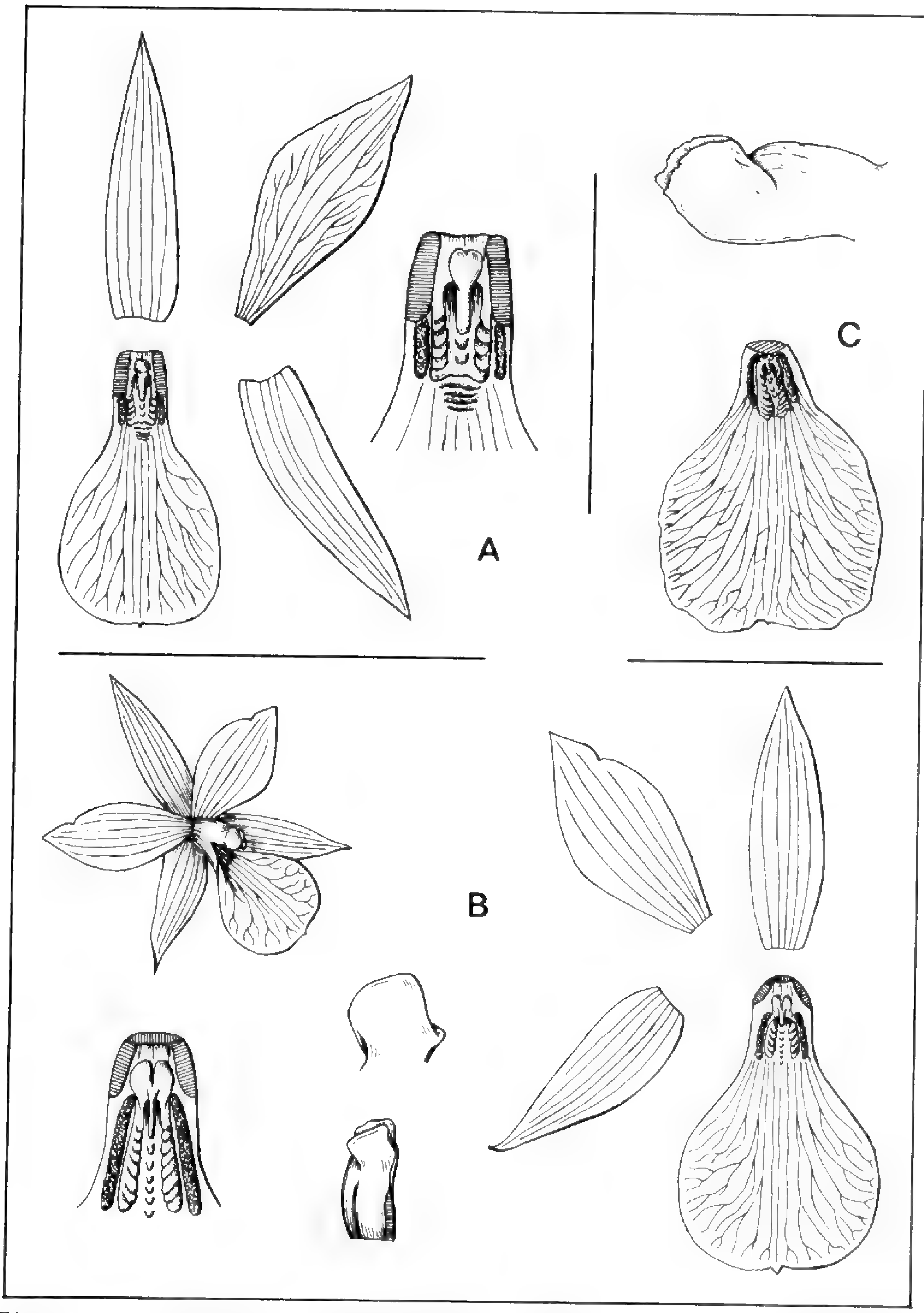

Plate 39. A. *Dimerandra elegans* (Focke) Siegerist. Type. B. *D. emarginata* (Meyer) Hoehne. Type. C. *D. emarginata* (Meyer) Hoehne. Type of *Epidendrum lamellatum* Westc. ex Lindl.

PLATE 40

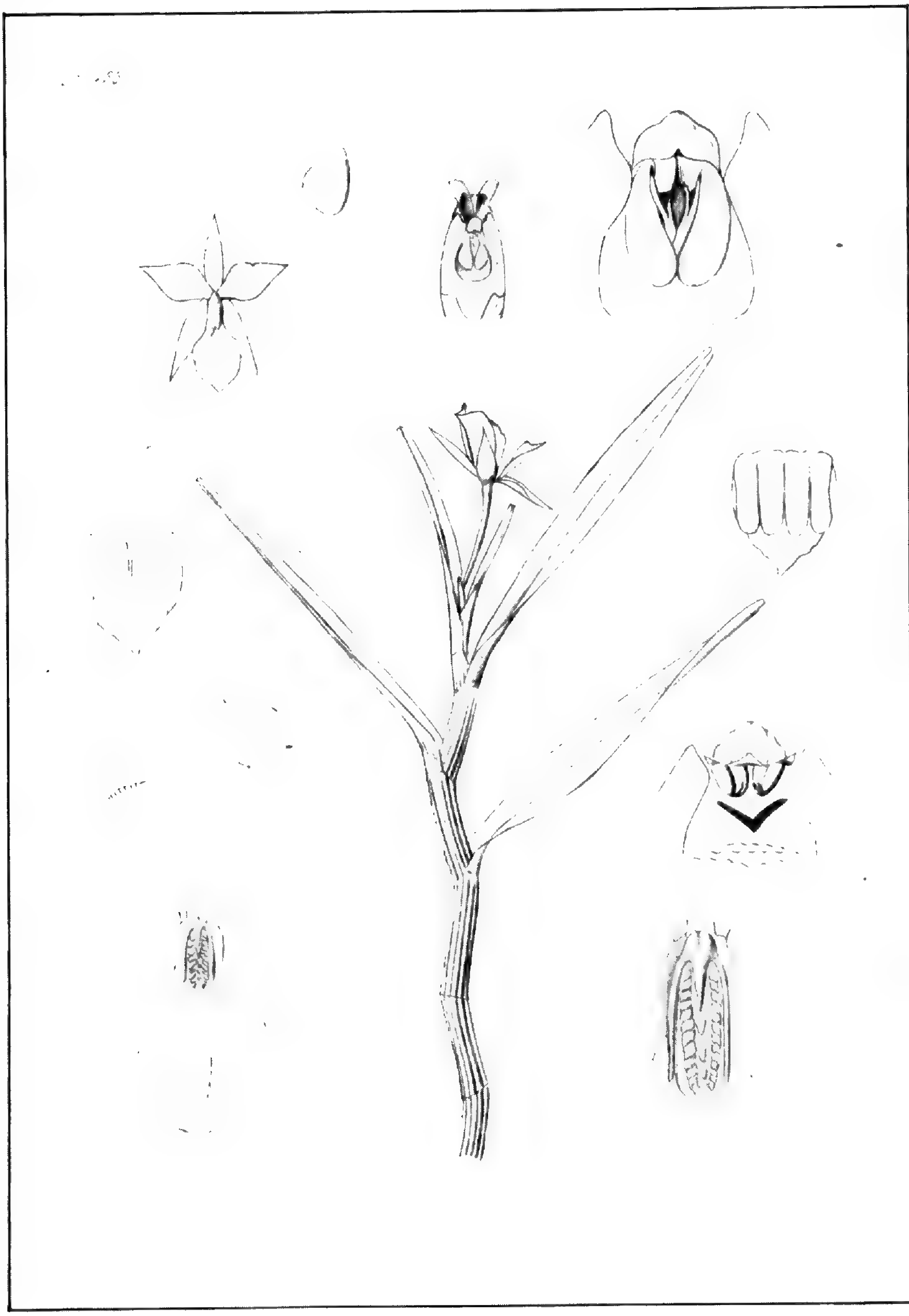

Plate 40. *Dimerandra emarginata* (Meyer) Hoehne. Drawing by Endres.

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OLIM VANILLACEAE

Leslie A. Garay

During the last 25 to 30 years much has been written about the evolution, phylogeny and the systematics of the orchid family. To comment here on all of those papers and books in detail surely would exceed the number of their printed pages. Some of those papers dealing with these subjects are exceptionally good in providing important new data, the majority of them, however, fall rather short in their purported goals. Admittedly, during the past quarter of a century I myself did find it almost irresistible at times not to board some of the popular eclipsing trains of the then prevailing trends and techniques in evolutionary biology, such as cytology, cytogenetics, numerical and/or chemotaxonomy, scanning electron microscopy, not to mention the most recent promises of cladistics. While they all made, or are still making, their respective contributions within their own discipline, none by themselves have provided the satisfactory answer or answers for which we are still searching, namely the understanding of the present-day complexity of the orchid family. The present contribution is no exception. In the following pages I merely propose to share some of the insights that I have gained during my studies of a small group of interrelated plants together with pertinent data published about them by others elsewhere.

Oh those seeds!

Already in 1960 I was much intrigued during my studies of the evolution and systematics of orchids by the occurrence of certain unique seed types in a few, totally unrelated genera. In these seeds all layers of the outer integument and most of the inner integument together form the seed coat which tightly surrounds the embryo; moreover, the outermost layer of the outer integument becomes sclerotic and completely opaque due to the accumulation of infiltrating materials inside the cells and their walls (Swamy 1947, 1949). As opposed to this condition, in the remaining orchid genera, the plants have seeds in which during development the cells of the outermost layer of the integument lose their protoplasts, thus, the seed coat becomes transparent, hence, tunicate. Both Swamy (1949) and Netolitzky (1926) have emphasized that multilayered, opaque and highly sclerotic seed coats are found usually in the relatively primitive orchids. Since at that time Apostasia, Adactylus, Neuwiedia, Selemipedium and Vanilla were the only genera known to me with sclerotic seeds, in agreement with Swamy and Netolitzky, I brought into focus this fact stating that "It is remarkable that the presence of a primitive type of seed in the Apostasioideae, Cypripedioideae and Neottioideae corresponds to the respective status of these groups."

This latter statement has been interpreted recently as a circular reasoning by Burns-Balogh and Funk (1986) in their cladistical analysis of the orchid family. They are quite emphatic that "A character is not primitive because it is found in a primitive group. Our results agree with those of Rasmussen (1983 sic!): the sclerotic seed coat is more likely secondarily derived." Although the authors do not demonstrate how they obtained their results, it is refreshing to know that the loss of protoplasts of the cells in the seed coat is a primitive condition in the Orchidaceae. If their claim is a fact, then the former MICROSPERMAE must be regarded as the most primitive group of the Monocotyledons. What a revolutionary idea! Of course, Rasmussen (1982) said "I can see no morphological obstacles against regarding the seeds of Vanilla and Galeola as derived from ordinary orchid seeds." Where Rasmussen appears to have no visionary problems in his own assumptions in refilling the cells, then multiplying the layers, Burns-Balogh and Funk treat them as proven evidence. And this is how some of the cladistic trees in phylogeny grow!

Indeed, I myself can see no morphological obstacles to derive the origin of tunicate seeds from such winged-type, sclerotic seeds as found in Eriaxis, Epistephium and Clematepistephium, or even from such as are found in *Neuwiedia Griffithii* and *N. veratrifolia* through the reduction in the number of layers of the integument. Future investigators may find it rewarding to study those seeds which still exhibit the remnants of some possible steps in an ancient ontogeny which are pointing to that direction, and which have remained unaltered in the cul-de-sac of saprophytism. Such possible steps may be changing from ovoid seeds (Vanilla) to lenticular ones with a cellular edge *(Cyrtosia javanica)* to several-layered keels *(Galeola septentrionalis)*, to truly alate seeds (Eriaxis, Epistephium, Clematepistephium). The step (from here ?) to the one-layered, tunicate testa is, however, a major one which remains yet to be demonstrated.

As a matter of fact, the recently published new information about certain orchids with sclerotic seeds stimulated me to review here the group once called by Lindley the Vanilla family. For the first time good photographs of the fruits and seeds of Rhizanthella, a subterranean orchid from Australia, were provided by George and Cook in 1981. Although differently sculptured, the seeds are those of the Vanilla type, and so are also the fleshy, indehiscent fruits with parietal placentation; these fruits also have a scent like Vanilla (Anonymous 1982). Both Veyret (1981) and Dressler (1983) have published excellent photographs of the cross sections of ovaries of various Palmorchis species revealing an axile placentation similar to that of Apostasia, while the sclerotic seeds are also of the Vanilla type. These bits of new information shed more light on their actual phylogenetic affinities than the various speculations already offered in print. These papers also prompted me to survey all the genera and species which have been attributed in the broadest sense to the relationship of Vanilla, Palmorchis and Rhizanthella in the past.

It must be emphasized that in any reliable systematic, evolutionary or phylogenetic study the examination of every species in every genus is crucial, because not every one of them provides important information. All of the so-called systems, including the recently published cladistic surveys, are based only on what-ever material was available to the researchers, as evidenced by their long list of exsiccatae, the usefulness of which, impressive as they appear, all add up to the value of a hay stack.

Remarks on the tribe Vanilleae.

When Lindley established the family VANILLACEAE in 1835, as a separate group next to the ORCHIDACEAE, he characterized it with one sentence: "Seeds with tight skin" *versus* "Seeds in a loose skin". The following year he gave a full description of this plant family with emphasis on the uniqueness of its associate characters (Lindley, 1836). "I separate Vanilla and Epistephium from Orchidaceae because of their succulent valveless fruit, of their seeds not having the loose testa which exists in all true Orchidaceae, and of their peculiar habit; to which may be added their aromatic properties. The winged seeds of *Vanilla* ? *pterosperma* [now = Galeola] form no exception to the character of the order [now = family], for their nucleus is as tightly coated by the testa as in common Vanilla". —Of course Vanillaceae as a family was abandoned by Lindley himself in 1840.

The succulent, indehiscent fruits with sclerotic seeds found in all Vanilla species are the essential characters of the foundation upon which the vanilla line must rest, regardless at what level above the genus it is studied. One of the early rewards of the above mentioned systematic review of genera and species is the recognition of these foundation characters in Cyrtosia plants. The genus itself was described by Blume in 1825, but since 1883 it was successfully buried in Galeola by Bentham and Hooker notwithstanding Blume's additional observation made in 1837. The fruits and seeds of Rhizanthella, as already mentioned above, are also fully in line with the original circumscription set forth by Lindley.

While the fruits of Vanilla, Cyrtosia and Rhizanthella are unilocular with parietal placentation—contrary to the claims of Burns-Balogh and Funk that Vanilla has a "three chambered ovary"—Palmorchis is now known to have a three locular ovary with axile placentation, while the seeds are those of the Vanilla type. These crucial details of Palmorchis were not known to me in 1960, when I proposed the five subfamilies or distinct phyletic lines in the Orchidaceae. These phyletic lines were shown to have evolved in a parallel manner, a conclusion reached through the discussed disparities in their respective endomorphic and exomorphic features. In that phyletic spectrum Apostasioideae, Cypripedioideae and Neottioideae occupy the lesser evolved or primitive end, while Orchidoideae and Epidendroideae were shown to be advanced or derived. With the new data on Palmorchis the position of the subfamily Neottioideae is considerably strengthened with respect to the possible common ancestry of these subfamilies. The plants of Apostasia/Neuwiedia, Selenipedium and Palmorchis are all terrestrial with fibrous roots, plicate leaves, and have three-locular ovaries and apterous, sclerotic seeds. Moreover, Palmorchis shares with Vanilla, in addition to the sclerotic seed coat, other important characters, such as the incumbent anther with the pollinia unattached to the rostellum and the prominent stigma. Neobartlettia, commonly included in Palmorchis, needs to be reinstated because of the lack of fusion between the column and the lip. These are the only genera which I now regard to comprise the subtribe Vanillinae *sensu stricto*. It must be mentioned here that, while reviewing every species in the genus Vanilla, *V. Dietschiana* Edwall had to be removed into a genus of its own, because of the sympodial growth habit of the plants, their undifferentiated leaves and bracts and the completely free floral segments. Another species, *Vanilla calyculata,* known to me only from the original description and illustration, needs further elucidations. The presence of the epicalyx (hypocalyx of Rasmussen) i.e., the calyculate ovary is indeed unique in the genus, but I consider that this structure has evolved more than once independently in the Neottioideae. Because of the presence of the calyculus in the plants of Lecanorchis, this latter genus has always been assigned to the subtribe VANILLINAE notwithstanding the very disharmonious colunmar structures and the tunicate seeds.

The remaining genera directly or indirectly mentioned by Lindley and commonly followed even today, i.e., Epistephium, Galeola and also Eriaxis, I consider to form a new subtribe, GALEOLINAE beside VANILLINAE. The plants of these genera always have dry, dehiscent fruits with prominently winged, sclerotic seeds. *Epistephium smilacifolium* Rchb.f. from New Caledonia has justly been elevated to a genus of its own by Hallé (1977) because of the scandent habit of the plants and their unique, three-locular ovary with axile placentation in addition to its geographical separation. I have personally studied plants of this species in the field in New Caledonia together with those of Eriaxis. The plants of this latter genus, however, contrary to the statements of Burns-Balogh and Funk, have a unilocular capsule with parietal placentation. The genus Galeola itself in its present status is an assemblage of strikingly discordant elements. Having removed Cyrtosia, I also find it necessary to reinstate from synonymy the genus Erythrorchis on account of the plants being saprophytic, the long and slender column of the flowers provided with a short but distinct foot, and the nature of the adnation of the lip to the column-foot. Also widely different from the original characters of Galeola is a third group of plants with large foliaceous bracts; the long, slender footless column of the flowers is basally fused with the lip to form a small, saccate to subtubular nectary. For these plants I propose a new genus based on their twining habit and Vanilla-like flowers in addition to the above mentioned characters.

Systematic considerations.

In reassessing the genera here grouped around Vanilla as was originally perceived by Lindley, we find that some of the component parts in the past were quite distantly removed from one another. Both Rhizanthella and Palmorchis are currently regarded as representatives of their own subtribes. Their actual positions have been shifted from one subfamily to another, they have even been allocated to separate subfamilies concurrently, thus, expressing not even a most tenuous relationship between them. Indeed, the position of the VANILLEAE or rather VANILLINAE has always been problematic, especially so when practical applications were considered. A review of the various individual approaches not attempted here, because in principle such an undertaking would not provide any new information. Yet, with a fleeting comment one must mention the latest effort by Burns-Balogh and Funk (1986) in their Phylogenetic Analysis of the Orchidaceae. This treatise is heavily dependent on another recently published phylogenetic or cladistic study by Rasmussen (1982). Whereas Rasmussen's discourses, in order to present a seemingly coherent picture in outlining hypothetical lineages, are liberally saturated with such factual words and phrases as "imagined", "probably", "may be derived", "possibly" or even "I believe" to mention a few, Burns-Balogh and Funk accept all such assumptions as facts. Although Rasmussen emphasizes that the study of phylogeny or cladistics is basicly independent of classificatory problems, Burns-Balogh and Funk base their new system of orchid classification on cladistics. In reality their "New System" is a mere half-digested mish-mash made unique by their lack of comprehension of the distinction between facts and hypotheses offered by other investigators. Finally this "New System" is brought to perfections through their lack of familiarity with the requirements of the International Code of Botanical Nomenclature. With respect to this latter phenomenon we are presented with two new tribal names, PRASOPHYLLEAE and PTEROSTYLIDEAE, as nomenclatorial transfers without supporting basionyms.

As a matter of fact, future students will find in the genera and species commonly assigned to the subtribes PRASOPHYLLINAE, DIURIDINAE, GASTRODIINAE and EPIPOGONINAE, the latter of which also includes the genus Sylvorchis J. J. Sm., another well-defined evolutionary line in the Neottioideae, which is not only comparable in advancement to, but which has also evolved in a parallel manner with the line of the Orchidoideae.

The purpose of this paper, however, is to bring together and interpret as well the known facts and sundry details pertaining to the Vanilla tribe for future students of orchid systematics, or even possibly for those of cladistical phylogenetics, rather than to propose new hypotheses. These facts and details are presented here in the form of a key to genera, which in turn is a summary of the current make-up of the VANILLEAE as I understand it.

Subfamily Neottioideae, the Tribe Vanilleae.

1. Seeds sclerotic - TRIBE VANILLEAE 2
1a. Seeds tunicate .... TRIBE NEOTTIEAE
2. Fruits succulent, indehiscent; seeds exalate - SUBTRIBE VANILLINAE 3
2a. Fruits dry, dehiscent; seeds winged - SUBTRIBE GALEOLINAE 8
3. Plants autotrophic 4
3a. Plants saprophytic 7
4. Leaves plicate; ovary three-locular, hence placentation axile 5
4a. Leaves conduplicate; ovary unilocular, hence placentation parietal 6
5. Lip bassally fused with column .... **Palmorchis**
5a. Lip free from column to base .... **Neobartlettia**
6. Growth habit sympodial; plants rhizomatous; leaves and bracts undifferentiated, reticulately veined; lip free from column .... **Dictyophyllaria**
6a. Growth habit monopodial; plants scandent; leaves and bracts differentiated, none reticulately veined; lip basally united with column .... **Vanilla**
7. Plants terrestrial; infloresсnece with small bracts and fully exposed flowers produced in succession, racemose to paniculate; lip fused with base of footless column .... **Cyrtosia**
7a. Plants subterranean; inflorescence with large, imbricating bracts completely hiding the flowers and forming a capitulum; lip articulate with column-foot, mobile .... **Rhizanthella**
8. Wings of seeds oval to elliptic in outline, entire; plants foliaceous 9
8a. Wings of seeds often deeply cleft, biparted; plants aphyllous...11
9. Leaves rather thin when dry, prominently reticulate; ovary glabrous, variously calyculate; flowers glabrous 10
9a. Leaves rigid when dry, obscurely reticualte; ovary tomentose, without a calyculus; flowers tomentose .... **Eriaxis**
10. Plants twining, vine-like; ovary with axile placentation, three-locular [New Caledonia] .... **Clematepistephium**

10a. Plants erect, caespitose; ovary with parietal placentation, unilocular [Tropical America] . . . . **Epistephium**

11. Plants with slender stems; rachis glabrous; flowers thin, glabrous; column slender, erect; lip easily flattened, explanate 12

11a. Plants with stout stems; rachis pubescent-furfuraceous; flowers fleshy, furfuraceous to pubescent; column stout, arcuate-clavate; lip cup-shaped to saccate, cannot be flattened . . . . **Galeola**

12. Bracts at base of branches small, non-foliaceous; column with a short, descending foot, tapering into the thick, median ridge of lip; pollinia solid; lip with numerous transversely parallel ridges on both sides of median ridge . . . . **Erythrorchis**

12a. Bracts at base of branches foliaceous; column footless; pollinia granular-farinaceous; lip basally fused with column forming a short, saccate nectary; disc of lip densely verrucose . . . . **Pseudovanilla**

Nomenclatorial matters.

Dictyophyllaria Garay, *Gen. nov.*

Etymology: *dictyon* = net, mesh and *phyllarion* = small leaf; in reference to the appearance of the leaves and bracts.

Sepala petalaque subsimilia, libera, plus minusve patentia; labellum convolutum, liberum; columna libera, gracilis, subclavata, facie glaberrima; clinandrium cucullatum; anthera incumbens, bilocularis; pollinia 2, exappendiculata, pulvereogranulosa, rostello haud affixa, sessilia; stigma sub rostello tranversum, subreniforme.

Plantae terrestres, ut videtur semper ramosae, basi radicantes, rhizomatis interdum ramosis; caules erecti, ramosi, foliati, foliis sursum decrescentibus exeuntibusque, laminis supra distincte reticulato-plurinervulosis; flores satis parvi, subsessiles, segmentis plus minusve patulis; ovarium gracile; fructus cylindricus, indehiscens, niger; semina sclerotica, exalata, nitida.

Typus: **Vanilla Dietschiana** Edwall.

Enumeration of species.

Dictyophyllaria Dietschiana (Edwall) Garay, *comb. nov.*

Basionym: *Vanilla Dietschiana* Edwall in Revist. do Centr. Sci. Letr. e Art. de Campin. No. 4: extr. p.1, t.2, July 1903.

Reported from: Brazil.

OBSERVATION: The sympodial growth habit, the reticulately veined leaves and bracts and the free lip are characters which are not present in Vanilla. The reticulate venation of the undifferentiated leaves and bracts are reminiscent of those found in Epistephium.

Cyrtosia Bl., Bijdr. pt. 8: 396, 1825.

"Perigonium pentaphyllum, erecto-connivens. Labellum ecalcaratum, concavum, ima basi ungui gynostemii continuum; limbo erecto, integerrimo. Gynostemium brevissime unguiculatum, subincurvum, apice subfornicatum. Anthera terminalis, opercularis, bilocularis. Pollinia duo, tereti-falcata, farinoso-pulposa, libera. Bacca siliquaeformis, carnosa. Semina in pulpa nidulantia, aptera. — Herba terrestris, caulescens. Caules erecti, continui, foliis nanis squamaeformibus instructi. Flores laxe spicati, mediocres." Blume in Rumphia 1: 199, 1837.

LECTOTYPUS: **Cyrtosia javanica** Bl. [Rumph. 1:199,1837].

ENUMERATION OF SPECIES.

Cyrtosia integra (Rolfe ex Downie) Garay, *comb. nov.*
Basionym: *Galeola integra* Rolfe ex Downie in Kew Bull. 409, 1925.
REPORTED FROM: Thailand, Laos.

Cyrtosia javanica Bl., Bijdr. pt. 8: 396, Tabellen f.6, 1825.
Syn: *Galeola javanica* (Bl.) Benth. & Hook., Gen. Pl. 3: 590, 1883.
REPORTED FROM: Ceylon, Vietnam, Thailand, Malaya, Sumatra, Java, Borneo.
OBSERVATION: The identification of the plants described by J. J. Smith under this name in Bull. Jard. Bot. Buitenzorg, ser 2, 9: 12, 1913, and illustrated in Bull. Jard. Bot. Buitenzorg ser. 3, 5(3): t.25, f.3, 1922, because of the floral details, especially the glabrous lip, is highly questionable, so is the material reported and illustrated by G. Seidenfaden from Thailand in Dansk Bot. Arkiv 32(2): 130, 1978.

Cyrtosia minahassae (Schltr.) Garay, *comb. nov.*

Basionym: *Galeola minahassae* Schltr. in Fedde, Rep. 10: 6, 1911.

REPORTED FROM: Celebes.

OBSERVATION: Although the details of the lip are almost identical with those of found in *C. javanica,* the columnar structure is very different in both species.

Cyrtosia nana (Rolfe ex Downie) Garay, *comb. nov.*

Basionym: *Galeola nana* Rolfe ex Downie in Kew Bull. 409, 1925.

REPORTED FROM: Thailand.

Cyrtosia septentrionalis (Rchb.f.) Garay, *comb. nov.*

Basionym: *Galeola septentrionalis* Rchb.f., Xenia Orch. 2: 78, 1865.

REPORTED FROM: Japan.

Subtribus Galeolinae Garay, *subt. nov.*

Plantae sympodiales, erectae vel scandentes, interdum volubiles; capsulae siliquaeformes, dehiscentes; semina membranaceo-marginata vel valde alata.

TYPUS: **Galeola** Lour.

Erythrorchis Bl. in Rumphia 1: 200, 1837.

"Perigonium pentaphyllum, erecto-connivens. Labellum ecalcaratum, ima basi ungui gynostemii concretum: limbo erecto, sublobato. Gynostemium brevissime unguiculatum, subincurvum, clavatum [basi in pedem brevem productum]. Anthera terminalis, opercularis, bilocularis. Pollinia duo, conduplicata, solidiuscula, libera. Capsulae siliquaeformes, inanes, rimis 2-3 longitudinalibus dehiscentes. Semina membranaceo-marginata [potius alata]. Herba terrestris, aphylla. Caules sarmentosi, nodoso-articulati, ad nodos radicantes squamis solitariis, pro foliis, instructi. Flores laxe spicati." Syn.: *Haematorchis* Bl. in Rumph. 4: t.200B, 1848. *Ledgeria* F. Muell., Fragm. 1: 238, 1859.

TYPUS: **Cyrtosia altissima** Bl.

Erythrorchis altissima (Bl.) Bl. in Rumph. 1: 200, 1837.
Basionym: *Cyrtosia altissima* Bl., Bijdr. pt. 8: 396, 1825.
Syn.: *Haematorchis altimssima* (Bl.) Bl. in Rumph. 4: t.200B, 1848.
Galeola altissima (Bl.) Rchb.f., Xenia Orch. 2: 77, 1865.
REPORTED FROM: Malaya, Java, Borneo, Philippines.

Erythrorchis cassythoides (A. Cunn. ex Lindl.) Garay, *comb. nov.*
Basionym: *Dendrobium cassythoides* A. Cunn. ex Lindl. in Bot. Reg. 21: *sub* t. 1828, 1836.
Syn.: *Ledgeria aphylla* F. Muell., Fragm. 1: 239, 1859.
Erythrorchis aphylla (F. Muell.) F. Muell., Fragm. 2: 167, 1861.
Galeola cassythoides (A. Cunn. ex Lindl.) Rchb.f., Xenia Orch. 2: 77, 1865.
REPORTED FROM: Australia.

Erythrorchis ochobiensis (Hayata) Garay, *comb. nov.*
Basionym: *Galeola ochobiensis* Hayata, Icon. Pl. Formos. 6: 87, 1916.
REPORTED FROM: Assam, Tenasserim, Thailand, Vietnam, Cambodia, Malaya?, Taiwan, Ryukyu Islands, Japan.

Observation: Previously this species has been considered to be synonymous with *E. altissima.* The rather slender to almost filiform fruits, in addition to the mutually exclusive distribution pattern, readily separate the two from one another.

Pseudovanilla Garay, *Gen. nov.*

Etymology: *Pseudo* = false and *Vanilla* = a generic name; in reference to the casual similarity of the plants in both genera.

Sepala petalaque plus minusve similia, patentia, nisi petala angustiora; labellum convolutum basi columnae adnatum et cum ea nectarium sacculatum formantium, disco multipapilloso; columna apoda, elongata, paululo arcuata, gracilis, apice subclavata, facie glaberrima; clinandrium humile; anthera majuscula, cucullata, quadrangularis, plus minusve incumbens, imperfecte bilocularis; pollinia 2, bipartita, exappendiculata, pulvereo-granulosa, libera; stigma sub rostello haud bene evolutum, suborbiculere.

Plantae terrestres, alte scendentes, aphyllae vel foliis bracteiformibus ad basin ramorum satis magnis, sursum descrescentibus; inflorescentiae ramosae, pluriflorae; flores conspicui, segmentis patulis; ovarium cylindricum; fructus cylindricus, dehiscens; semina prominenter alata.

TYPUS: **Ledgeria foliata** F. Muell.

ENUMERATION OF SPECIES.

Pseudovanilla affinis (J. J. Sm.) Garay, *comb. nov.*

Basionym: *Galeola affinis* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 2, 9: 7, 1913.

REPORTED FROM: Java.

Pseudovanilla anomala (Ames & L. O. Wms.) Garay, *comb. nov.*

Basionym: *Vanilla anomala* Ames & L. O. Wms. in Bot. Mus. Leafl. Harv. Univ. 5: 108, 1938.

REPORTED FROM: Fiji Islands.

Pseudovanilla foliata (F. Muell.) Garay, *comb. nov.*

Basionym: *Ledgeria foliata* F. Muell., Fragm. 2: 167, 1861.

Syn.: *Erythrorchis foliata* F. Muell.. Fragm. 2: 167, 1861, *nom. alter.*

Galeola foliata (F. Muell.) F. Muell., Fragm. 8: 31, 1873.

Galeola Ledgeri Fitzger., Austr. Orch. 2(2): t., 1885.

Galeola montigena Schltr. in Fedde, Rep. Beih. 1: 29, 1911.

REPORTED FROM: Australia, New Guinea.

Pseudovanilla gracilis (Schltr.) Garay, *comb. nov.*

Basionym: *Galeola gracilis* Schltr. in Fedde, Rep. Beih. 1: 28, 1911.

REPORTED FROM: New Guinea.

Pseudovanilla philippinensis (Ames) Garay, *comb. nov.*
Basionym: *Galeola philippinensis* Ames, Sched. Orch. 6: 5, 1923.
REPORTED FROM: Philippines.

Pseudovanilla ponapensis (Kaneh. & Yamam.) Garay, *comb. nov.*
Basionym: *Vanilla ponapensis* Kaneh. & Yamam, in Trans. Nat. Hist. Soc. Form. 23: 21. 1933.
Syn.: *Galeola ponapensis* (Kaneh. & Yamam.) Tuyama in Journ. Jap. Bot. 16: 632, 1940.
REPORTED FROM: Ponape Island.

Pseudovanila ternatensis (J. J. Sm.) Garay, *comb. nov.*
Basionym: *Galeola ternatensis* J. J. Sm. in Bull. Jard. Bot. Buitenz. ser. 3, 5: 16, 1922.
REPORTED FROM: Moluccas, Ternate Island.

Pseudovanilla vanilloides (Schltr.) Garay, *comb. nov.*
Basionym: *Galeola vanilloides* Schltr. in Fedde, Rep. Beih. 1: 29, 1911.
REPORTED FROM: New Guinea.

ACKNOWLEDGMENT.

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DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXVIII

ETHNOBOTANICAL NOTES ON CUCURBITS OF THE NORTHWEST AMAZON

Richard Evans Schultes

Recent ethnobotanical field studies in the northwestern Amazon, especially in Colombia, have revealed a series of interesting uses of cucurbitaceous species, especially as medicines. These uses serve to support the growing belief that the Cucurbitaceae deserves more intensive phytochemical investigation for biodynamic secondary organic constituents.

Many of the following notes on uses of Amazonian cucurbits were made during my 14 years of ethnobotanical studies in the northwest Amazon from 1941 to 1954 or on subsequent annual trips to the region. I have drawn upon the field observations of my former student, Dr. H. V. Pinkley, and upon notes published by P. Le Cointe in his *A Amazônia Brasilerira III. Arvores e Plantas Uteis* (Livraria Classica, Belém do Pará, 1934) and upon the collections of several other botanists who have worked in the area.

I am indebted to Dr. C. Jeffrey of the Royal Botanic Gardens, Kew, for identification of most of the collections cited below. Most of the specimens are preserved in one or more of the following institutions: the Economic Herbarium of Oakes Ames and the Gray Herbarium, both of Harvard University, and the Herbario Nacional de Colombia in Bogotá.

Cayaponia glandulosa (*P. et E.*) *Cogniaux* in A. et C. DeCandolle, Monogr. Phan. 3 (1881) 755.

Colombia: Comisaría del Amazonas, Río Loretoyacu, "Vine up to 20 m long, forming great tangles along river bank. Calyx tube green; petals fleshy, green.

Fruit ellipsoidal, 3.7 × 23 cm, ripening red. Monoecious", January 28–February 7, 1969. *Plowman, Lockwood, Kennedy et Schultes 2369.*
PERU: Departamento del Amazonas, Río Cenepa, Quebrada Huampamí. May 1973. *Kayap 819.*

The local name of *Cayaponia glandulosa* is reported to be *yuwish* in the Río Cenepa region of Peru. The Tikunas of the Río Loretoyacu chop up the fruits and boil them into a tea which is taken to relieve "liver complaints." They also dry and powder the leaves and young stems of this vine to prepare an insect repellent dust for use in hammocks and clothes.

Cayaponia kathematophora *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 20 (1964) 339.

This extensive vine is cultivated by the Indians in the middle course of the Río Apaporis of Colombia for its unusually large, shining, brown seeds which, when hollowed out, are employed in the manufacture of anklets and necklaces. The Makunas know the plant as *ka'-moo-ka.* The Taiwanos call it pa-moo'-pa. In the Kabuyarí language, it is *wa'-cha*; in Puinave *way-yot';* and in Matapie *wa'yaw.*

Cayaponia ophthalmica *R. E. Schultes* in Bot. Mus. Leafl. Harvard Univ. 20 (1964) 321.

The soft green bark of *Cayaponia ophthalmica* is employed in preparing a soothing wash for treating conjunctivitis, without a doubt the most widespread disease amongst the Indians of the northwest Amazon. The vine, a strong heliophile, is frequently cultivated by Indians in the basin of the Río Apaporis of Colombia. Like so many cultivated plants of these Indians, it grows almost without care along the edge of agricultural plots, where *Manihot* and *Erythroxylon* are set out, but it is definitely planted and cared for for its medicinal use.

A spot test for alkaloids with Dragendorff reagent indicates that the plant from which this collection came is negative.

Cayaponia Ruizii *Cogniaux* in A. et C. DeCandolle, Monogr. Phan. 3 (1881) 794.

COLOMBIA: Comisaría del Putumayo, Río Guamués, Santa Rosa. November 28, 1966. *Pinkley 564.*

ECUADOR: Provincia del Napo, Río Aguarico, Dureno. "Fruit orange when ripe, one-seeded." October 9, 1966. *Pinkley 506.*

According to the collector, the seed is edible when roasted for five minutes. The Kofáns call this plant *sau-ra'-kit-sa* and *kan-bi'-fa-cho.*

Cayaponia triangularis *Cogniaux* in A. et C. DeCandolle, Monogr. Phan. 3 (1881) 784.

In the Brazilian Amazon, the fruits and roots of this plant, known as *purga de gentio,* are valued as a strong purgative (Le Cointe, loc. cit.).

Cayaponia sp.

ECUADOR: Provincia del Napo, Río Aguarico, Dureno. *Pinkley 222* (Cited in H. V. Pinkley: *The Ethnoecology of the Kofán Indians* [Ph.D. thesis, ined.] Harvard University (1973).

Stems of this species of *Cayaponia* are reportedly burned and, amongst the Kofáns, the ashes are applied to external sores on the ankles. The Kofán name of this vine is *cho-rok-o-pee-sĕ'-hĕ-pa.*

Cyclanthera explodens *Naudin* in Ann. Sci. Nat., ser. 4, 12 (1859) 160.

C. brachystachya (Ser.) Cogniaux, Diagn. Cucurb. 2 (1877) 64.

COLOMBIA: Comisaría del Putumayo, Valle de Sibundoy, ca. 2200 m. "Vine, 4 m; flowers and fruit green. Common in borders." March 17, 1963. *Bristol 640.*

The Kamsá Indians of Sibundoy call this species *semarrón-shajush* and consider it a medicine, but the precise medicinal use is not indicated by the collector.

Fevillea amazonica (*Cogn.*) *C. Jeffrey* in Kew Bull. 16 (1962) 199.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. August-September 19, 1945. *Schultes 6732.*

Amongst the Tikunas, the oil from the seeds of *Fevillea amazonica* is reputed to hasten the healing of serious burns when applied three or four times a day over a period of ten days.

Fevillea cordifolia *Linnaeus,* Sp. Pl. (1753) 1013.

ECUADOR: Provincia del Napo, Río Aguarico, Dureno. February 7, 1966. *Pinkley 103.*

The Kofáns call this vine *ata'-cho* and extract an oil from the seeds to polish necklaces made of various kinds of seeds. At one time, according to the collector, the seed was burned for light.

Gurania acuminata *Cogniaux,* Diagn. Cucurb. 1 (1877) 31.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, La Pedrera, "Vine, flowers orange", April 1944. *Schultes 4880;*—Same locality and date. *Schultes 5887.*

In the region of La Pedrera, the natives believe that a tea of the leaves of *Gurania acuminata* is one of the most effective vermifuges.

Gurania bignoniacea (*P. et E.*) *C. Jeffrey* in Kew Bull. 33 (1978) 354.

COLOMBIA: Comisaría del Amazonas, Río Putumayo, road between Caucaya and La Tagua. May 17, 1942. *Schultes 3750.*—Río Amazonas, Leticia. November 1948. *Schultes et López 10401.*

Comisaría del Vaupés, Río Apaporis, mouth of Río Pacoa. "Vine. Flowers orange. Fruit with light and dark green patches." July 17, 1951. *Schultes et Cabrera 13045.*—Jinogojé, at mouth of Río Piraparaná. "Flowers orange." February 27, 1952. *Schultes et Cabrera 15657.*—Soratama. "Climber. Flowers red and yellow." March 26, 1952. *Schultes et Cabrera 16084.*

Extensive medicinal use is made of this vine. The Makuna Indians of the Río Piraparaná crush the leaves and flowers and apply the vegetal material to infected cuts and sores that refuse to heal; the Makuna name is *hĕ'-nĕ-gaw.* The Tukanos, living in the same general region, prepare the leaves and roots in a tea which is taken as a vermifuge; the Tukanos know the plant as *mee'-chee.*

It is interesting that Colonos—people from the interior regions of Colombia who have settled in the town of Caucaya—rub the leaves of *Gurania bignoniacea* on areas of the skin affected by fungal infections. This use may have been adopted from the Indians.

Gurania eriantha (*P. et E.*) *Cogniaux,* Diagn. Cucurb. 1 (1877) 16.

COLOMBIA: Comisaría del Amazonas, Río Putumayo, Florida. May–June 1931. *Klug 2267.*

The name of this vine amongst the Witotos of the Río Putumayo is reported to be *usiya-o.*

Gurania Guentheri *Harms* in Notizbl. 9 (1926) 990.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Conejo and vicinity. April 2–5, 1942. *Schultes 3514.*

The Kofáns of the Río Sucumbios call this vine *ya-ma-cho'-ro* and take an infusion of the leaves as a strong vermifuge.

Gurania insolita *Cogniaux* in Engler, Pflanzenr. 66, iv, 275, 1 (1916) 209.

COLOMBIA: Comisaría del Amazonas, interior regions of Trapecio Amazónico. "Vine. Flowers scarlet; petals yellow." September 1946. *Schultes 8235.*

The Tikuna Indians prepare the crushed flowers as a poultice applied cold to boils and similar infected sores.

According to Jeffrey, this collection is mixed: the flowers belong to *Gurania insolita,* the leaves to *Cayaponia ophthalmica.*

Gurania pachypoda *Harms* in Notizbl. 9: 991, 1926.

COLOMBIA: Comisaría del Amazonas, Trapecio Amazónico, near Puerto Nariño, "Herbaceous vine growing in secondary growth among tree tops. Corolla fleshy, bright orange; anthers yellow." January 28–February 7, 1969. *Plowman, Lockwood, Kennedy et Schultes 2329.*

PERU: Departamento del Loreto, Río Amazonas, Iquitos and vicinity, Moyuy, "Corolla yellow, calyx orange. Vine climbing to 6 m in secondary growth", July 14, 1967. *Martin, Plowman et Lau-Cam 1618.*

In the region of Puerto Nariño at the mouth of the Río Loretoyacu, the Tikuna Indians employ the crushed leaves as a poultice to relieve headache.

In the Iquitos region, the vernacular name of this vine is reported to be *mashu-mikuna.*

Gurania rhizantha (*P. et E.*) *C. Jeffrey* in Kew Bull. 33 (1978) 357.

Dieudonnaea rhizantha (P. et E.) Cogniaux in Bull. Soc. Bot. Belg. 14 (1875) 239.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. September–November 1944. *Schultes 6064*.—Interior regions of Trapecio Amazónico. "Woody vine, 3 inches in diameter. Flowers vermillion." October 1945. *Schultes 6753*—Río Loretoyacu. September 1946. *Schultes et Black 8392*.
ECUADOR: Provincia del Napo, Río Aguarico, Dureno. January 3, 1966. *Pinkley 67*.—Same locality. February 22, 1966. *Pinkley 135*.

Tikuna women in the Río Loretoyacu area prepare a tea of the roots and woody stems of this common vine for a condition which, according to description, seems to be extremely irregular menstruation. Amongst the Kofáns, the plant has two names: *akie-ka-kie-sĕ'-hĕ-pa* and *cho-rok-o-pi';* the leaves are dried and reduced to ashes which are spread on sores of the skin.

Gurania rufipila *Cogniaux,* Diagn. Cucurb. 1 (1877) 30.

COLOMBIA; Comisaría del Amazonas, Río Miritiparaná, Caño Guacayá. "Vine. Flowers vermillion. On flood banks." March 4, 1952. *Schultes et Cabrera 15809*.

The Tanimuka Indians known this vine as *mee-ree-fee'-ka-no-ma-ka*. The stem and roots are reputedly toxic, and care must be taken not to confound it with similar species of *Gurania* which are being collected for medicinal purposes.

Gurania speciosa (*P. et E.*) *Cogniaux,* Diagn. Cucurb. 1 (1877) 16.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu, near Puerto Nariño, on trail to Río Putumayo. August 1964. *Raffauf 106*.

This collection gave a questionably positive alkaloid reaction to a Dragendorff spot-test on fresh material.

Gurania spinulosa (*P. et E.*) *Cogniaux,* Diagn. Cucurb. 1 (1877) 17.

COLOMBIA: Comisaría del Putumayo, Río Sucumbios, Santa Rosa." Flowers red, yellow within. Vine." April 7–8, 1942. *Schultes 3565*.—Río Caquetá, Puerto Limón. "Vine. Flowers orange; petals yellow." March 17, 1955. *Schultes et Cabrera 18718*.

Comisaría del Amazonas, Río Loretoyacu. "Vine. Flowers orange." September–November 1944. *Schultes 6020; 6333*.—Río Amazonas, Leticia. September 1946. *Schultes 8218.*—Río Loretoyacu. October 1946. *Schultes et Black 8559.*

In the region of the Río Loretoyacu, a tea of the roots is employed for the same condition (faulty menstruation) as *Gurania rhizantha.*

Gurania Ulei *Cogniaux* in Engler, Pflanzenr. 66, iv, 275, 1 (1916) 205.

COLOMBIA: Comisaría del Amazonas, Río Putumayo, Florida. May–July 1931. *Klug 2120.*

The Witoto Indians call this vine *maruchao.*

Lagenaria siceraria *(Mol.) Standley* in Field Mus. Publ. Bot. 3: 435, 1930).

In the Brazilian Amazon, the pulp of the fruit in the ripened stage is considered to be emollient. It is also employed as a laxative. A tea of the seeds is considered efficaceous against nephritis (Le Cointe, loc. cit.).

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THE CARYOCARACEAE AS A SOURCE OF FISH POISONS IN THE NORTHWEST AMAZON

KAZUKO KAWANISHI[1], ROBERT F. RAFFAUF[2]
AND RICHARD EVANS SCHULTES[3]

The Caryocaraceae is a family of tropical American trees. The family has two genera—*Anthodiscus* and *Caryocar*—with some 25 species. It is believed to be allied to the Theaceae. The family has recently been revised by Prance and Freitas da Silva (1).

Caryocar *Allamand ex Linnaeus*

The fifteen species of *Caryocar,* trees or rarely shrubs or suffruitices (herbaceous with a woody stem base), occur in the humid tropics from Costa Rica and Colombia throughout lowland South America; the genus is particularly well represented in the Amazon and the Guianas.

The fruit and seeds of several species are valued by local populations as food, and some interest in the group has been in evidence as undeveloped plants of potential commercial value (2). Perhaps the best known is *Caryocar brasiliense* Camb. of central Brazil, the seeds of which yield an oil said to be an excellent cooking oil, a butter substitute and a source of fat for home soap-making; the fruits are used to prepare a native liqueur (3). In other parts of northern South America, the *sauri trees* or *sauri-nut trees*—*C. amygdaliferum* Mutis and *C. nuciferum* L.—are likewise the sources of edible fat, and *C. nuciferum*

[1]Present address: Kobe Women's College of Pharmacy, Motoyamakita-Machi, Higashinada-Ku, Kobe 658, Japan.
[2]Medicinal Chemistry Section, College of Pharmacy and Allied Health Professions, Northeastern University, Boston, MA; Research Associate, Botanical Museum, Harvard University, Cambridge, MA.
[3]Charles Edward Jeffrey Professor of Biology and Director, Botanical Museum, Harvard University, Emeritus, Cambridge, MA.

is cultivated in the West Indies for its "butter nuts" or "sauri nuts" (4). In the Guianas, *C. glabrum* (Aubl.) Pers. is known as *soapwood* and is used for washing hair and clothing (4). *Caryocar villosum* (Aubl.) Pers. likewise yields a fat similar to and used as butter and in soap-making in Brazil, where its product is called *manteiga de pequía* ("pequía butter"); in French Guiana, the tree is called *arbre a beurre* ("butter tree") (3); it was introduced into Malaysia in the 1920's (5), and the analysis of its fruits was reported (6).

There is some evidence from our own ethnobotanical studies in the Colombian Vaupés that Caryocar may have biodynamic or even toxic constituents. The Tukano Indians, for example, prepare a paste of the crushed leaves of *Caryocar gracile* Wittm. which, when fed to dogs, causes slow death within a week. *Caryocar microcarpum* Ducke appears to have insecticidal properties. The botanical explorer von Martius suggested that the root bark of a species of *Caryocar* may enter into the preparation of an Amazonian curare (7).

During the course of a plant-collecting trip to the northwestern Amazon, two of the authors (RFR and RES) observed that the leaves of *Caryocar microcarpum* are repellent, if not toxic, to leaf-cutting ants; relatively few of the insects, having attempted (and usually succeeded) in cutting pieces of leaf from a fresh collection, exhibited random, disoriented behavior and dropped leaf bits along a trail but a few yards from the site where the collection of leaves had been set out to dry; scores of the ants appeared to be dead or paralyzed and dying. These insects are responsible for enormous crop losses throughout tropical America (8).

In earlier literature, *Caryocar* is frequently cited under its local names, especially those species employed in Brazil (*piquí, piquí-a, piquiarana, pequí, pekéa,* etc.) without reference to species identification; and the chemical studies that have been given the genus have been concerned primarily with fats and oils (9). These constitutents have often been compared to olive and palm oils.

The physical properties of the oils and their glyceride compositions have been determined (10). The oil of *Caryocar villosum* is rich in phytosterols and iron but has a bitter taste; that of *C. microcarpum* (syn. *C. butyrosum* sensu Staehl) is marked (11). Carotenoids and significant amounts of provitamin A have been reported in piqué oils (12). Recently, de Oliveira and his co-workers found extracts of *C. brasiliense* to have some activity against Sarcoma 180, due mainly to their content of oleanolic acid; friedelin, friedelinol, β-sitosterol, stigmasterol and ellagic acid were also isolated (13).

With the exception of these brief notes, we are unaware of basic studies of either the chemistry or the pharmacology of this small New World plant family.

The use of *Caryocar* as a fish poison in the northwest Amazon of Brazil and Colombia is interestingly unique. A hole is dug in the ground—approximately two feet in depth. It is filled repeatedly with water, until the loose earth remaining at the base of the hole is a semi-liquid mud; it may on occasion be stirred vigorously by pounding with a piece of wood or section of a tree trunk as a pestle. Fruits of the *Caryocar* are then dumped into the hole. Pounding to mix the fruits with the mud and to crush the pericarp of the fruit is then carried on for twenty minutes or more, after which the mixture is cast into still water. The effects are rapid; the water becomes muddy or cloudy, and fish come to the surface for air and are caught by hand. During the pounding of the fruit-mud mixture and when it is thrown into the water, extensive foaming is evident, indicating a high saponin content.

Several species of *Caryocar* are employed as fish poisons by all Indian tribes in the Comisaría del Vaupés of Colombia and adjacent areas of Brazil. It is noteworthy that this method of fishing, relatively laborious in comparison with the use of the many other icthyotoxic plants of the region, is so widespread and clearly one of the preferred procedures amongst the numerous Tukanoan tribes of the Vaupés.

The Colombian voucher specimens cited are preserved in the Economic Herbarium of Oakes Ames and/or in the Gray Herbarium (both of Harvard University) and in the Herbario Nacional de Colombia; the Brazilian specimens cited are in the collection of the New York Botanical Garden. The identifications have been checked or made by Dr. Ghillean T. Prance;

most of the collections have been cited in the monograph by Prance and Freitas da Silva (1).

Caryocar glabrum (*Aubl.*) *Persoon,* Syn. Pl. 2 (1806) 84.

BRAZIL: Estado do Amazonas, basin of Río Negro, Unciuxí, Makú Indian village 300 km. above mouth. October 1971, *Prance et al. 15576.*—Same locality. "Forest on terra firme. Tree 20 ml. × 30 cm. diam. Corolla yellow; filaments purple. Fruit ground up for potent fish poison." October 24, 1971, *Prance et al. 15583.*

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. "Large tree, 75 feet. Stamens red, petals yellow. Fruit used as a fish poison." August 20, 1961, *Schultes et Cabrera 13600.*—Soratama. "Enormous tree. Flowers yellow; stamens bright red. Seeds uncooked used as foods." September 26, 1951, *Schultes et Cabrera 14139.*—Soratama. "Rind of fruit used as fish poison. Fruit light brown. Seeds eaten by natives. Wood very hard." January 28, 1932, *Schultes et Cabrera 14999.*—Portage between Ríos Vaupés and Apaporis. "Tree 15 m. In forest. Flower buds pale green. Flowers with calyx pale green; corolla pale yellow; stamens bright red, showy. Pulp of fruit used as fish poison. The seed is edible." September 17, 1976, *Zarucchi 2090.*—Río Vaupés, Between Río Paraná Pichuna and Rapids of Mandí. "Tree 13 m.; in primary forest. Fruits orange-brown, immature. Fruit pulp used as fish poison." November 12, 1976, *Zarucchi 2223.*—Río Vaupés, Raudal Tutú. "A tree. 20 m. Fruit globose, rusty brown. Seed white, edible. Rind of fruit and pulp crushed in mud holes to prepare a fish poison—it foams up." March 29, 1975, *Zarucchi, Schultes et McElroy 1121.*—Alto Río Papurí, Caño Yapú. March 31, 1977, *Patmore et Dufour 60.*

Caryocar glabrum is widespread in the Amazon valley and the Guianas. In the Colombian Vaupés, this tree is known in Spanish as *barbasco de monte* and *barbasco propio.* The Puinvave Indians call it *ho'-shoo* or *haw.* The Kubeos refer to the tree as *kon.* In Barasana, the name is *e-ho'.* The Makú Indians on the Brazilian Rio Unciuxí know it as *pursh.* Prance reported the use of this species as fish poison amongst the Makú (14).

Caryocar gracile *Wittmack* in Martius, Fl. Bras. 12, Pt. 1 (1886) 350.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, near mouth. "Tree in high savannah forest. Flowers pink. *Barbasco.*" June 1952, *Cabrera sine num.*

C. gracile is not so widely distributed as many of the other species; it is known only from the northwest Amazon in the Vaupés in Colombia, in the Estado do Amazonas in Brazil and in adjacent parts of southern Venezuela. It is known locally in Spanish as *barbasco* and is one of several species employed as a fish poison.

Caryocar microcarpum *Ducke* in Arch. Jard. Bot. Rio Jan. 4 (1925) 133.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Miraflores. February 1944, *Gutiérrez et Schultes 828.*—Caño Guaracú. February 21, 1944, *Gutiérrez et Schultes 867.*—Río Apaporis, Soratama. "Small tree along inundated bank." June 17, 1951, *Schultes et Cabrera 12646.*—Río Kuduyarí, lowermost rapids. "Tree 60 feet. Flowers white; stamens pink. Leaves will paralyze leaf-cutting ants." October 10, 1966, *Schultes et Raffauf 24390.*—Río Kuduyarí. "Tree 10 m. tall, overhanging river. Inundated terrain. Fruit green in a terminal cluster. Seed coat spiny, imbedded in a white pulp." January 26, 1975, *Zarucchi 1328.*—Same locality . "Tree 12 m. tall, along river, inundated. *Barbasco.*" August 4, 1975, *Zarucchi 1469.*—Same locality. "Tree 12 m. tall along river. Specimens collected at 10 p.m. (flowers open after dark and fall before morning). Flowers with calyx and corolla pale greenish white; stamens bright pink, fragrant. *Barbasco del* río." November 10, 1946, *Zarucchi 2207.*

The distribution of *C. microcarpum* is very extensive and probably as a result of its wide range, the species is unusually variable. It occurs in the Amazon and in Venezuela and the Guianas. However, we have been unable to find reference to its ichthyotoxic use except in the northwestern sectors of Brazil and Colombia. The Kubeo Indians of the Vaupés call this tree *kun'-kuj* and *ku'*. The Spanish names of the species are *barbasco* and *barbasco del río,* referring undoubtedly to the riparian distribution of the species.

Preliminary chemical studies have been carried out on the leaves of *C. microcarpum* (*Schultes et Raffauf 24390*). The results are summarized briefly here; experimental details will be published elsewhere. The collection gave a negative spot test for alkaloids on fresh material using Dragendorff's reagent. Hexane extraction yielded a complex mixture of triterpenes and a soft cuticular wax. Subsequent extraction with alcohol and appropriate partition of the extract followed by lyophilization gave about 40% of a powder rich in tannins of the ellagic/gallic acid type and triterpene saponins with the basic oleanane skeleton. This chemistry is certainly consonant with the native use of the leaves; saponins are known to be insecticidal and ichthyotoxic

(15); tannins are important inhibitors of the grazing of plants by herbivores of many types (16). Indeed, triterpenes of the oleanane type have been found to be toxic to termites (17) and attine ants (18). In our opinion, an assessment of *Caryocar* as a commercial crop should include further study of the non-edible portions of the plants as sources of compounds or their derivatives potentially toxic to insects.

Anthodiscus *C. F. W. Meyer*

The ten species of *Anthodiscus* are trees or shrubs ranging in tropical parts of northern South America in the Guianas, Venezuela and the westernmost Amazon of Brazil, Colombia and Peru.

It is of pertinent interest that our ethnobotanical field studies indicate that several species of *Anthodiscus* are similarly employed by Indians in the Colombian Vaupés. The ichthyotoxic use of two species was reported earlier (19). Unfortunately, material of the three species known to be sources of fish poisons in the Vaupés have not been available for phytochemical study. Apparently little or nothing is known about the chemical composition of the genus (9).

Anthodiscus obvatus *Bentham ex Wittmack* in Martius, Fl. Bras. 12, Pt. 1 (1886) 358.

COLUMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. "Small tree. Flowers yellow." November 27, 1951, *Schultes et Cabrera 14660.*—Río Apaporis, Raudal Yayacopi. "Bush. Flowers yellow." August 18, 1952, *Schultes et Cabrera 16924.*—Río Vaupés, Raudal de Yuruparí. "Small bush by falls. Sandy soil. Fish poison." August 1960, *Cabrera sine num.*

The Tukano Indians of the Colombian Vaupés, besides using this plant as a fish poison, employ it as an ingredient, together with *Strychnos,* in preparing a type of curare.

The Tanimuka name of *Anthodiscus obovatus* is *tee-fĕ-roo'-ka.* In the Makuna language, it is *ko-men'-tan-go* or *gaw'-we.* The Makús call it *chee-aw'.*

Anthodiscus peruanus *Baillon* in Adansonia 10 (1872) 241.

COLOMBIA: Comisaría del Vaupés, Río Negro, Caño Ducuruapo. "Tall tree, 34–40 feet; diameter 18 inches. Wood hard, white. Bark shaggy, dark brown. Flowers bright yellow. Leaves very glossy, light green. In caatinga." December 13–17, 1947, *Schultes et López. 9387.*

The Kuripako Indians use this tree as a fish poison.

Anthodiscus pilosus *Ducke* in Trop. Woods 90 (1947) 23.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. August 16, 1951, *Schultes et Cabrera 13561.*—Río Apaporis, Jinogojé. "On high knoll. Tree 90 feet. Flowers yellow." June 8, 1952, *Schultes et Cabrera 16623.*—Río Popeyacá, June 10, 1952, *Schultes et Cabrera 16623.*

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DE PLANTIS TOXICARIIS E MUNDO NOVO TROPICALE COMMENTATIONES XXXVII

MISCELLANEOUS NOTES ON MEDICINAL AND TOXIC PLANTS OF THE NORTHWEST AMAZON

Richard Evans Schultes
and Robert F. Raffauf

Research on the biodynamic plants of the northwest Amazon, especially that part lying within the borders of Colombia, has continued to add to the large number of plants with biological activity—plants deserving of scientific study for the benefit of mankind.

This series has continued to note the uses of plants as medicines, poisons or narcotics that the Indians of the northwest Amazon have, through millennia of trial and error, discovered to possess some activity on the human or animal body. It is on these plants—rather perhaps than on a random sampling of the 80,000 species in the Amazon Valley—that modern phytochemists and pharmacologists should focus their attention.

With the rapid encroachment and success of acculturation, the folk-knowledge acquired through hundreds of years by aboriginal peoples is rapidly being lost. There is little time to lose, and scientists must come to realize the practical value to us of Indians' knowledge of the properties of their ambient vegetation.

It is probable that this region of the northwest Amazon has one of the richest ethnopharmacopoeias in tropical America. The region may also be the richest in species of plants of the Amazon Valley, an area slightly larger than the United States.

An amazingly large number of different tribes inhabit this region, all of them—at least until the last few years—more or less dependent on their local flora for "medicinally" useful plants for treatment of their ills. Their knowledge of the properties of plants is extraordinarily extensive. This knowledge has, until now, been preserved primarily because the area—rivers clogged with endless rapids and waterfalls—has by nature been protected from penetration by "civilized" influences from Brazil, bringing with them the availability of efficient and inexpensive western medicine.

With such a rich flora and indigenous population and since most of the species have never been phytochemically investigated, the northwest Amazonian forests offer an unexplored emporium of new chemicals, some of which may be of potential value in our own pharmacopoeias.

Most of the material cited in this paper was gathered during my 40 or more years of field work in the northwest Amazon. An appreciable number of the ethnopharmacological notes are taken from field notes of my students, many of whom have carried out field work in the region. A few of the data have been gleaned from the literature or from annotations on herbarium specimens.

The literature sources in the following pages are the following: Glenboski—*The Ethnobotany of the Takuna Indians of Amazonas, Colombia* (Instituto Ciencias Nat., Biblioteca J. J. Triana, Univ. Nac. Col., Bogotá, 1983); von Reis Altschul—*Foods from Little-Known Plants: Notes in the Harvard University Herbaria* (Harvard Univ. Press, Cambridge, Mass., 1973); von Reis and Lipp: *New Plant Sources for Drugs and Foods from the New York Botanical Garden Herbarium* (1982); La Rotta: *Observaciones Ethnobotánicas sobre algunas Especies Utilizadas por la Comunidad Indígena Andoque (Amazonas, Colombia),* Corporación de Araracuara (1983). T. Uphop—*Dictionary of Economic Plants,* Verlag J. Cramer, Lehre, Germany, (1968).

The families in the following pages are arranged in accord with the Engler-Prantl system. The genera are listed alphabetically under the family. Most of the voucher herbarium specimens are preserved in the Economic Herbarium of Oakes Ames or in the Gray Herbarium (both of Harvard University) and/or in the Herbario Nacional de Colombia in Bogotá.

The preceding contributions in this series have been published in the *Botanical Museum Leaflets of Harvard University*, the *Journal of Ethnopharmacology*, the *Journal of Psychoactive Drugs*, *Rhodora* and *Lloydia*.

PIPERACEAE

Peperomia macrostachya *(Vah) A. Dietrich* var. **nematostachya** *(Link) Trelease et Yunker*, Piperaceae N.S. Am. 2 (1950) 661.

COLOMBIA: Comisaría del Vaupés, Mitú. "Hanging epiphyte." September 27–October 20, 1966. *Schultes et Raffauf 24178.*

A Dragendorff alkaloid spot-test gives a negative result for this epiphyte.

Peperomia obtusifolia *(L.) A. Dietrich*, Sp. Pl. 1 (1831) 154, fig. 574.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Yapobodá. Ocotober 4–6, 1951. *Schultes et Cabrera 14270.*

The Kubeo Indians rub the crushed leaves of this piperaceous plant vigorously on rheumatic joints to reduce the pain.

Peperomia pellucida *(L.) Humboldt, Bonpland et Kunth*, Nov. Gen. et Sp. 1 (1815) 64.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 20–30, 1945. *Schultes 6622.*

Amongst the Tikuna Indians, leaves of this epiphytic plant are crushed and, after soaking in warm water, are poulticed on ulcers and wounds.

Peperomia victoriana *C. DeCandolle* in DC. Prodr. 16 (1869) 449.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Lagos de Pasos. February 19, 1944. *Gutiérrez et Schultes 857.*

The natives living in the upper Río Vaupés rub the crushed leaves on the forehead to relieve headaches.

Ficus caballina *Standley* in Field Mus. Nat. Hist. Bot. 13 (1936) 301.

COLOMBIA: Comisaría del Amazonas, Río Boiauasú. November 1945. *Schultes 6817*.
Comisaría del Vaupés, Río Naquieni, Cerro Monachí, June 1948. *Schultes et López 10065*.

This tall tree has thick white latex which the Tikunas employ as a bone-set. The latex "sets" rapidly to a rather hard mass.

Ficus gemina *Ruiz ex Miquel* in Martius, Fl. Bras. 4, Pt. 1 (1853) 98.

COLOMBIA: Comisaría del Amazonas, Leticia. "Fruit yellow, red spotted. Latex white. Tree." September 1946. *Schultes 8177*.
Comisaría del Vaupés Río Macaya, Cachivera del Diablo. "Extensive strangler. Bark rough, mottled grey and ashy white or brown with red-brown areas. Latex abundant, thin, white, or cream-coloured, rapidly oxidizing to a brownish orange on contact with air. Fruit green-yellow with red spots before ripening, later a pink with darker red spots. Leaves inhabited and eaten by an insect perfectly camouflaged to blend with the dark, glossy upper surface. Grows on sandy, well-drained soil but near water." May 1943. *Schultes 5393*.

The Tikunas of the Río Loretoyacu call this wild fig *pai'-n* and value the latex as a vermifuge. In the Vaupés, the tree is known as *chivecha*. The latex is spread on the skin to relieve itching due probably to fungal infections.

Ficus glabrata *Humboldt, Bonpland et Kunth* var. **obtusula** *Dugand* in Caldasia 3 (1944) 136.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. "Enormous tree, 120 feet. Buttress roots. Latex white, October 1946. *Schultes et Black 8443*.—Río Putumayo, between Ríos Igaraparaná and Yaguas, Isla Arica. June 20, 1942. *Schultes 3499*.
Comisaría del Putumayo, Río Caucaya. May 18, 1942. *Schultes 3788*.

The Tikuna Indians of the Río Loretoyacu employ the latex as a vermifuge; they call the tree *po-ta'*. It is known locally in Spanish as *higuerón*.

Ficus Mathewsii *Miqel* in Ann. Mus. Bot. Lugd. Bot. 3 (1867) 298.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. September 13–15, 1966. *Schultes et Raffauf 24112.*

This wild fig gave an alkaloid-negative result with a Dragendorff reagent spot-test.

ANNONACEAE

Guatteria Duckeana *R. E. Fries* in Acta Hort. Berg. 12 (1939) 468.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Tree, 45 feet. Flowers green." October 10, 1966. *Schultes, Raffauf et Soejarto 24377.*

The Indians living near this rapids report that bathing or rubbing with a warm decoction of the leaves is efficaceous in relieving rheumatic pains. The fresh leaves are alkaloid-positive with a Dragendorff spot-test.

Duguetia odorata *(Diels) Macbride* in Field Mus. Nat. Hist. Publ. Bot. 4 (1929) 172.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí. "Tree 12 feet. Flowers green-yellow." October 10, 1966. *Schultes, Raffauf et Soejarto 24382.*

The flowers are dried and mixed with chicha to impart an aromatic flavour.

A Dragendorff spot-test on fresh leaves and bark indicates that both are very strongly alkaloid-positive.

MYRISTICACEAE

Compsoneura capitellata *(A.DC.) Warburg* in Nov. Act. Nat. Cur. 68 (1897) 146.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. January 31, 1952. *Schultes et Cabrera 15107.*

The Indians in the region of Soratama assert that the roots of this small tree are very poisonous but that no use is being made of them.

Compsoneura debilis *(A.DC.) Warburg* in Nov. Act. Nat. Cur. 68 (1897) 144.

COLOMBIA: Comisaría del Vaupés, Río Negro, San Felipe, October 25, 1952.

Schultes, Baker et Cabrera 18018.—Río Vaupés, Yutica. May 14–17, 1953. *Schultes et Cabrera 19374.*

The Desano Indians, who know this small tree as *bee-a'-poo-nee,* state that the root is highly toxic. No known use is made of it.

Virola calophylla *(Spr.) Warburg* in Nov. Act. Acad. Leop.-Carol. 68 (1897) 231.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu, October 1946. *Schultes et Black 8463.*—Río Caquetá, La Pedrera, May 2, 1952. *Schultes et Cabrera 16381.*

Comisaría del Vaupés, Río Apaporis, Soratama. August 16, 1951. *Schultes et Cabrera 13587.*—Same locality. March 26, 1952. *Schultes et Cabrera 16040.*

The Yucuna name for this tree is *a-rĕ'-dje.*It is one of the several species of *Virola,* the bark exudate of which is widely appreciated in the Colobian Amazonia in the treatment of fungal infections of the skin.

Virola flexuosa *A. C. Smith* in Brittonia 2 (1936) 151.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. September 28, 1951. *Schultes et Cabrera 14166.*

The Taiwano Indians of the Río Kananarí call this tree *e-ta'-pa-ma* and report that the dried and pulverized leaves are an excellent insect repellent.

Virola loretensis *A. C. Smith* in Bull. Torr. Bot. Club 58 (1931) 95.

COLOMBIA: Comisaría del Amazon, Río Loretoyacu. November 1945. *Schultes 6947.*

The Tikuna Indians of the Río Loretoyacu apparently do not employ any species of *Virola* in the preparation of an intoxicating snuff or orally ingested "pill." They point out, however, that this is one of the trees employed by the neighboring Witotos as a source of a narcotic "pill."

Virola Melinonii *(Ben.) A. C. Smith* in Brittonia 2 (1938) 502.

BRAZIL: Estado do Amazonas, Rio Negro basin, Rio Cauaburí. "Small tree. Flowers brownish yellow. No bark resin seen." July 15, 1967. *Schultes 24569.*

A Dragendorff spot-test for alkaloids gave a negative result.

Virola multinervia *Ducke* in Journ. Wash. Acad. Sci. 24 (1936) 261.

BRAZIL: Estado do Amazonas, Manáos and vicinity. Reserva Ducke. "Tree 45 feet; diameter 8–10 inches. Abundant red resin-like exudate in bark. Leaves beneath and fruits golden-hairy." July 30, 1967. *Schultes 24614.*

This tree gave a negative result with a Dragendorff spot-test for alkaloids. The twigs, root and fruit, however, were positive with an Ehrlich test.

Virola peruviana *(A.DC.) Warburg* in Nov. Acta Acad. Leop.-Carol. 68 (1897) 188.

COLOMBIA: Comisaría del Amazon, Río Loretoyacu. September–November 1944. *Schultes 6031.*

The Tikunas of the Río Loretoyacu employ the resin-like liquid in the inner bark to treat fungus attacks on the skin.

LAURACEAE

Nectandra acutifolia *(R. et P.) Mez* in Jahrb. Bot. Gart. Berl. 5 (1889) 409.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Tree, 40 feet. Flowers yellow." October 10, 1966. *Schultes, Raffauf et Soejarto 24373.*

The Kubeos drink warm a tea prepared from the bark to relieve "excessive fatigue."

With a Dragendorff spot-test, the fresh bark is alkaloid-positive.

Ocotea opifera *Martius,* Reise Bras. 3 (1831) 1128.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Urania. "Tree, 30 feet. Fruits green." October 12, 1966. *Schultes, Raffauf et Soejarto 24421.*

The fruit of this tree is dried and crushed, and the powder is mixed with coca by the Kubeos. The plant is alkaloid-negative with a Dragendorff spot-test.

Phoebe sp.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Small tree. Fruit green." October 10, 1966. *Schultes, Raffauf et Soejarto 24374.*

The Kubeos of the Mitú region sprinkle powdered bark in their ceremonial featherwork to preserve it from insect damage.

A Dragendorff alkaloid spot-test on this collection gave a positive reaction.

MONIMIACEAE

Siparuna ternata *Perkins* in Engler, Jahrb. 28 (1901) 691.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Small tree." October 10, 1966. *Schultes, Raffauf et Soejarto 24375.*

This plant is alkaloid-negative with a Dragendorff spot-test on fresh material of the leaves.

Amongst the Kubeos, a decoction of the leaves and fruits is ingested to relieve chest congestion due to colds.

LEGUMINOSAE

Elizabetha princeps *Schomburgk ex Bentham* in Hooker, Journ. Bot. 2 (1840) 92.

BRAZIL: Estado do Amazonas, Rio Negro basin, Rio Cauaburí. "Bark burnt for ashes to mix with Virola snuff. Tree 40 feet. In forest." July 17, 1967. *Schultes 24578.*

The bark and petioles of this tree gave a negative test for alkaloids with Dragendorff reagent.

The Waika Indians call this tree *a-ma'*. The ashes of its bark are mixed with their hallucinogenic snuff known as *nyakwana* or *epena* (Schultes et Holmstedt: Rhodora 70 (1968) 113–160).

Inga nobilis *Willdenow,* Enum. Hort. Berol. (1809) 1047.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Jinogojé. "Bush. Flowers white." June 5, 1952. *Schultes et Cabrera 16004.*—Same locality. June 20, 1952. *Schultes et Cabrera 16767.*

The Makunas call this bush *mĕ-ñĕ-ra'.*

Inga setifera *DeCandolle,* Prodr. 2 (1825) 432, 615.

COLOMBIA: Comisaría del Amazonas, Leticia. "Flowers yellow. Fruit pulp edible. Leaves very glossy above." September 20, 1945. *Schultes 6543.*

Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. "Small tree. Flowers bright yellow." September 16, 1951. *Schultes et Cabrera 14024.*—Río Kuduyarí, lower part. "Cultivated. Flowers yellow." October 16, 1952. *Schultes et Cabrera 17860.*

This small tree is locally known in the Leticia area as *chimbillo.* Its name in Tikuna is *kau-ré*, and the Kubeos of the Rio Kuduyari call it *koo-mĕ'-nĕ.*

Inga stenoptera *Bentham* in Hooker Journ. Bot. 2 (1840) 143.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. March 1946. *Schultes 7136.*

Comisaría del Vaupés, Río Apaporis, Jinogojé. "Flowers white. Bush." August 28, 1952. *Schultes et Cabrera 17029.*—Río Vaupés, Mitú. November 13, 1952. *Schultes et Cabrera 18419.*

The Makú Indians of the Río Piraparaná know this plant as *meen.*

Stylosanthes guianensis *(Aubl.) Swartz* in Vet. Acad. Handl. Stockh. (1789) 296.

COLOMBIA: Comisaría del Vaupés, Río Kubiyú, Savannah Kañendá. "Herb. Flowers orange; stem covered with hairs. Profusely glandular." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24293.*

This leguminous herb is alkaloid-negative with a spot test on fresh material with Dragendorff reagent.

Swartzia conferta *Spruce ex Bentham* in Martius, Fl. Bras. 15, pt. 2 (1870) 20.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Cachivera de Tatú. "Small treelet. Fruit red." October 10, 1966. *Schultes, Raffauf et Soejarto 24371.*

Fresh leaves are alkaloid-positive when subjected to a Dragendorff spot-test.

BURSERACEAE

Hemicrepidospermum cuneifolium *Cuatrecasas* in Webbia 12 (1957) 417.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. "Small tree. Flowers greenish yellow. Leaves stiff." August 16, 1951. *Schultes et Cabrera 13592.*

The aroma of the dried leaves of this plant is presumed amongst the Tawaino Indians to relieve severe catarrhal conditions. These Indians know the plant as *kĕ-kĕ'-ta-me-tĕ*.

Meliaceae

Guarea gomma *Pulle* in Rec. Trav. Bot. Néerl. 6 (1909) 271.

Colombia: Comisaría del Amazonas, Interior of Trapécio Amazónica October 1945. *Schultes 6763.*—Río Boiauassú. "Small tree. Flowers white." November 1945. *Schultes 6791.*—Río Loretoyacu. November 3, 1946. *Schultes et Black* 46-303.

The leaves of *Guarea gomma* are considered by the Tikunas to be very astringent and are employed in the form of a tea to arrest diarrhoea. The roots are said to be toxic.

Guarea macrophylla *Vahl,* Eclog. Am. 3 (1807) 8.

Colombia: Comisaría del Caquetá, Río Caquetá, Tres Esquinas. *Little et Little 9653.*

The bark of *Guarea macrophylla* is employed locally as a purgative.

Malpighiaceae

Burdachia prismatocarpa *Martius ex Jussieu var.* **argutivenosa** Cuatrecasas in Webbia 13 (1958) 636.

Colombia: Comisaría del Vaupés, Río Vaupés, Mitú. November 17, 1939. *Cuatrecasas 7248.*

The Kubeo name of this plant is reported to be *va-da-kee'-ma-mae*. The leaves are said to be "medicinal", but their specific use is not known.

Byrsonima ciliata *Cuatrecasas* in Webbia 13 (1958) 623.

Colombia: Comisaría del Vaupés, Río Kuduyarí, Yapobodá. "Bush 18 feet. Flowers white. Leaves coriaceous, obovate, apically indented. Calyx green; petals white; stamens red." October 5, 1951. *Schultes et Cabrera 14217.*

The Kubeo Indians of the Río Vaupés consider a tea of the dried leaves of *Byrsonima ciliata* to be effective as a diarrhoetic.

Alchornea castaneifolia *A. Jussieu,* Tent. Euphorb. (1824) 42.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et Black 8439.*—Same locality. November 1946. *Schultes et Black 8635.*—Same locality. January 8, 1973. *Glenboski C-202.*

The Tikuna Indians make a decoction of the scrapings of the bark to treat diarrhoeia. According to the collector *(Glenboski C-202),* one tablespoonful of the tea should be taken before meals. The name of this species amongst the Spanish-speaking inhabitants of the region is *pájaro arbol.*

Alchornea triplinervia *(Spreng.) Mueller-Argoviensis* in De Candolle, Prodr. 15, pt. 2 (1862) 909.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, El Encanto. May 22–28, 1942. *Schultes 3830.*

The Witotos claim that this plant has anti-diarrhoeic properties. The leaves are occasionally employed for this medicinal purpose.

Mabea nitida *Spruce ex Bentham* in Hooker, Kew Journ. 6 (1854) 367.

COLOMBIA: Comisaría del Vaupés, Mitú. "Tree 20 feet. Fruit rust-coloured." September 27–October 30, 1966. *Schultes et Raffauf 24170.*

Material of this tree is alkaloid-negative with a Dragendorff spot-test.

Micrandra minor *Bentham* in Hooker, Kew Journ. 6 (1854) 372.

BRAZIL: Estado do Amazonas, Rio Negro basin, Rio Cauaburí, Carangreijo. "Medium sized tree, by flood bank. Flowers yellow. Latex white. Common name: *arara-seringa.*" July 14, 1967. *Schultes 24564.*

With a Dragendorff spot-test for alkaloids, the petioles are positive (questionably so, since latex may interfere with the reaction); the inner bark is weakly positive.

Anacardiaceae

Anacardium occidentale *Linnaeus,* Sp. Pl. (1753) 383.

Colombia: Comisaría del Amazonas, Leticia. August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24037.*

The leave of this common cultivated treelet tested positive with Dragendorff reagent.

Bombacaceae

Matisia cordata *Humboldt et Bonpland,* Pl. Aequin. 1 (1808) 9, t. 2.

Colombia: Comisaría del Amazonas, Río Loretoyacu. "Tree 60 feet. Flowers yellow. Pulp of fruit edible." September 13–15, 1966. *Schultes et Raffauf 24111.*

A Dragendorff spot-test indicates that this collection is very strongly alkaloid-positive.

Sterculiaceae

Theobroma grandiflorum *K. Schumann* in Martius, Fl. Bras. 12, pt. 3 (1886) 76.

Colombia: Comisaría del Amazonas, Río Loretoyacu. September 13–15, 1966. *Schultes et Raffauf 24165.*

A Dragendorff alkaloid spot-test on the leaves gave a negative reaction.

Herrania Camargoana *R. E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 14 (1950) 120, t. 29, 32.

Brazil: Estado do Amazonas, Rio Negro basin, Rio Cauaburí. "One slender trunk. Height 20 feet. In flood forest. Fruit brownish red with fleshy pseudospines at junction of ribs and cross ribs." July 16, 1967. *Schultes 24571.*

A Dragendorff reagent spot-test for alkaloids is negative for the stems and petioles.

Davilla densiflora *Triana et Planchon* in Ann. Sc. Nat., ser. 4, 17 (1862) 18.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, El Encanto. May 22–28, 1942. *Schultes 3853.*

The "juice" of this plant is said to be very caustic. It is noteworthy that the "juice" of *Davilla rugosa* of Brazil is said to "burn the skin and for this reason is called 'fire vine' or *cipo de fogo*" (von Reis et Lipp, 1982).

Davilla nitida *(Vahl) Kubitzaki* in Mitt. Bot. Staatssaml. München 6 (1971) 95.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et Black 8540.*—Río Apaporis, Soratama. "Fruit orange. Shrub." January 26, 1951. *Schultes et Cabrera 12835.*

The Tikuna Indians of the Río Loretoyacu use a decoction of the leaves of this abundant shrub to cautarize bleeding wounds. In the Río Apaporis, the natives burn the leaves and put the ashes into gashes made by machetes to help staunch the flow of blood and, they say, to hasten the healing process.

Doliocarpus dentatus *(Aubl.) Standley* in Journ. Wash. Acad. Sci. 15 (1925) 286, *in obs.*

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, La Chorrera. June 18, 1974. *Sastre 3396.*

Comisaría del Vaupés, Río Kuduyarí, Yapobodá. "Low bush. Fruit red. Flowers white." October 5–6, 1951. *Schultes et Cabrera 14361; 14393.*

This is the famous *bejuco de agua* ("watervine"). The Kubeo Indians of the Río Kuduyarí report that the water from this vine will arrest the after-effects of malaria.

The Witotos of the Río Igaraparaná call this plant *jo-be'-o.*

Caryocaraceae

Anthodiscus obovatus *Bentham ex Wittmack* in Martius, Fl. Bras. 12, pt. 1 (1886) 358.

Brazil: Estado do Amazonas, Rio Xié. "Small tree. Flowers yellow. Leaves coriaceous." November 29–December 7, 1947. *Schultes et López 9226.*
Colombia: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. November 27, 1951. *Schultes et Cabrera 14660.*

The bitter bark of this tree is considered by the Indians of these Brazilian and Colombian localities to be a febrifuge when used in a decoction. The plant is also valued for its ichthyotoxic properties.

Quiinaceae

Quiina amazonica *A. C. Smith* in Trop. Woods No. 58 (1939) 30.

Colombia: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes 6676.*

The Tikuna Indians of the Río Loretoyacu drink a tea of the leaves to "cure" sores of the mouth.

Bixaceae

Bixa Orellana *Linnaeus,* Sp. Pl. (1753) 512.

Colombia: Comisaría del Amazonas, Río Caquetá, Caño Aduche. October 6, 1981. *La Rotta 26.*
Comisaría del Putumayo, Mocoa. December 3–7, 1942. *Schultes et Smith 3002.*

According to *La Rotta 26,* the Andoke Indians call this cultivated tree *acósi,* apparently a variant of the Spanish *achiote.*

Flacourtiaceae

Ryania pyrifera *(L. C. Rich.) Uitten et Sleumer* in Pulle, Fl. Surinam 3 (1935) 296.

Colombia: Comisaría del Vaupés, Raudal de Tatú. "Small tree. Flowers white." October 10, 1966. *Schultes, Raffauf et Soejarto 24387.*

This plant, reported to be an excellent fish-poison, is alkaloid-negative when tested on fresh material with a Dragendorff spot-test.

Passifloraceae

Passiflora laurifolia *Linnaeus,* Sp. Pl. (1753) 956.

Colombia: Comisaría del Vaupés, Río Vaupés, Mitú. Savannah at base of Cerro Mitú. "Extensive vine. Flowers white; staminodes tan; anthers bright yellow." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24207.*

The Kubeo Indians state that a decoction of the leaves of this vine can be taken to induce sleep.

Myrtaceae

Calyptranthes multiflora *Poeppig ex Berg* in Martius, Fl. Bras. 14, pt. 1 (1857) 42.

Colombia: Comisaría del Vaupés, Río Apaporis, Soratama. "Small tree. Fruit purple-brown. On flood bank." June 12, 1951. *Schultes et Cabrera 12642.*

The fruits are gathered and prepared in the form of a tea to treat a condition leading to abnormally swollen breasts. The tea is administered orally every few hours for two days. This treatment is recommended by the Taiwano Indians, who know the plant as *ö-kö-ta'-pa.*

Calyptranthes paniculata *Ruiz et Pavón,* Fl. Peruv. 4 (1799) t. 424.

Colombia: Comisaría del Vaupés, Río Apaporis, Soratama. August 16, 1951. *Schultes et Cabrera 13553.*—Same locality. "Small treelet. Fruit red. Common on flood banks." June 17, 1951. *Schultes et Cabrera 12613.*

A tea of the red berries of this treelet is given to women of the Barasana tribe of the Río Apaporis to increase the flow of milk from swollen breasts. The native informants say that the tea must be administered with care and in small doses.

Eugenia aff. **biflora** *(L.) DeCandolle,* Prodr. 3 (1828) 276.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Yapobodá. "Low bush, common on savannah." October 5, 1951. *Schultes et Cabrera 14236.*

The Kubeos report that a wash prepared from the leaves of this plant and introduced into the ear can relieve "pain and throbbing in the ear."

Eugenia aff. **cuspidiflora** *DeCandolle,* Prodr. 3 (1828) 279.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratma. June 21, 1951. *Schultes et Cabrera 12760.*

The Taiwano Indians living on the Río Kananarí call this plant *er-kĕ-te'-pa,* meaning "ear-medicine." It is used in the form of an infusion to relieve pressure from accumulated ear-wax.

Eugenia florida *DeCandolle,* Prodr. 3 (1828) 283.

COLOMBIA: Comisaría del Amazonas, Río Guacayá. "Bush. Flowers white, fragrant." April 24, 1952. *Schultes et Cabrera 16236.*—Río Apaporis, Jinogojé. June 5, 1952. *Schultes et Cabrera 16595.*

The Makuna Indians call this bush *oo-koo'.* They drink an infusion of the leaves to relieve pains in the chest.

Eugenia Patrisii *Vahl,* Eclog. Am. 2 (1807) 35.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. January 21, 1952. *Schultes et Cabrera 14922a.*

A tea of the leaves, twigs and fruits of *Eugenia Patrisii* is reputed by the Barasana Indians to be a valuable remedy for persistent coughs and other respiratory problems.

Marlierea insignis *McVaugh* in Fieldiana Bot. 29 (1956) 177.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. "Small tree, 35 feet. Fruit golden brown. In flood forest." August 24, 1951. *Schultes et Cabrera 13722.*

The edible fruit of *Marlierea insignis* is valuable in the form of a tea taken as hot as possible for treatment of what appears to be the results of a sinus condition. The tea is said to be snuffed into the nostrils to clear their congestion.

Marlierea Spruceana *Berg* in Martius, Fl. Bras. 14, pt. 1 (1857) 34.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. "Small tree. Fruit green, black when ripe, edible. On flood bank. July 18, 1951. *Schultes et Cabrera 12652*—Río Kananarí, Cerro Isabukuri, *Schultes et Cabrera 14697*—Río Vaupés, near Mitú. November 13, 1952. *Schultes et Cabrera 18414.*

The Puinaves have two names for this small tree: *de'-der* ("tree of the lapa") and *ha'-shan.* The Taiwanos of the Río Kananarí consider that a hot decoction can "clear the throat of congestion"; their name for the plant is *er-kĕ-la-te'-pa.*

Myrcia salicifolia *DeCandolle,* Prodr. 3 (1828) 246.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. "Tree 25–35 feet tall. Fruit red." September 16, 1951. *Schultes et Cabrera 14019.*

The leaves of *Myrcia salicifolia* are considered by the Taiwano Indians to be efficaceous against diarrhoea when taken dry and mixed with farinã (flour of *Manihot esculenta*) The leaves are said to be astringent and often emetic when used in excess.

Myrcia splendens *(Sw.) DeCandolle,* Prodr. 3 (1828) 244.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cachivera del Palito. "Small tree. Flowers white." July 25, 1951. *Schultes et Cabrera 13147.*—Río Apaporis, Jinogojé. June 5, 1952. *Schultes et Cabrera 16592.*

The bark of this small tree is widely employed to paint *cuyas* (gourds) black. The Puinaves call the plant *ta-we-ka'.*

Psidium acutangulum *DeCandolle,* Prodr. 3 (1828) 233.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. November 1946. *Schultes et Black 8630.*

The leaves appear to be very astringent and are valued by the Tikuna Indians to prepare a wash to relieve the pains of hemorrhoids.

Psidium densicomum *Martius ex DeCandolle,* Prodr. 3 (1828) 235.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. January 21, 1952. *Schultes et Cabrera 14947a.*

The fruit of this plant is frequently dried and kept for chewing to relieve "sores of the mouth" amongst Indians in the Rio Apaporis. It apparently has astringent properties.

Psidium guianense *Persoon,* Syn. 2 (1807) 27.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. *Glenboski C-241.*

The mature fruit is esteemed by the Tikunas when eaten raw "to lessen diarrhea" (Glenboski, loc. cit 50).

Trichilia Cipo *C. DeCandolle* in Martius, Fl. Bras. 11, pt. 1 (1878) 214.

Venezuela: Territorio del Amazonas, Río Negro, San Carlos. "Tree 45 feet, 6 inches in diameter. Flowers green-white. Bark fissured; hard inner bark red." December 15, 1947. *Schultes et López 9365a.*

The Kuripako Indians of the Río Guainía esteem a decoction of the bark as a cure for malaria and other fevers.

Trichilia micrantha *Bentham* in Hooker, Kew Journ. 3 (1851) 369.

COLOMBIA: Comisaría del Vaupés, Río Kananarí, Cerro Isibukuri. "Tree up to 50 feet. Flowers white. Fruit dark green." August 4, 1951. *Schultes et Cabrera 13317.*—Río Apaporis, Jinogojé. June 20, 1952. *Schultes et Cabrera 16782.*

The Barasana Indians, who know this tree as *yö-kö-nee,* employ the smoke of the burning leaves as a treatment for a variety of pulmonary ailments. It is reputedly extremely pungent.

Trichilia Pleeana *(A. Juss.) C. DeCandolle* in Martius, Fl. Bras. 11, pt. 1 (1870) 215.

COLOMBIA: Comisaría del Amazonas, Río Atacuari. "Tree 20 ft. Flowers white." October 24, 1946. *Schultes et Black 8592.* Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. August 12, 1951. *Schultes et Cabrera* 13527.

The Taiwano Indians of the region near the Raudal de Jerijerimo maintain that the bark of this tree is astringent and can be used as a febrifuge in the form of a tea.

Trichilia septentrionalis *C. DeCandolle* in Martius, Fl. Bras. 11, pt. 1 (1870) 220.

COLOMBIA: Comisaría del Putumayo, Río Uchupayacu. "Tree 30 ft., 20 cm." February 22–23, 1942. *Schultes 3303.*

The Ingano Indians consider that a tea of the leaves of this species is effective against fevers.

Trichilia singularis *C. DeCandolle* in Martius, Fl. Bras. 11, pt. 1 (1878) 217.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. November 1945. *Schultes 6946.*

The Tikuna Indians employ a tea of the leaves of this tree as a febrifuge.

MELASTOMACEAE

Graffenrieda rupestris *Ducke* in Arch. Inst. Bio. Veg. Rio Janeiro 2 (1935) 66.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Raudal de Jerijerimo. November 25, 1951. *Schultes et Cabrera 14560.*—Río Vaupés, Cachivera de Tatú. "Tree, 40 feet. Flowers white, fragrant." October 10, 1966. *Schultes, Raffauf et Soejarto 24381.*

The leaves of *Graffenrieda rupestris* are rubbed on the hands to relieve blisters caused by long paddling. A Dragendorff spot-test on living material indicates that these leaves are alkaloid-negative.

These two collections, the first from Colombia, are the westernmost localities for the species; the type of which is from the Cerro Curicuriarí on the upper Rio Negro of Brazil.

Macairea Schultesii *Wurdack* in Bot. Mus. Leafl., Harvard Univ. 18 (1958) 164.

COLOMBIA: Comisaría del Vaupés, Río Kubiyú, Savannah of Kañendá. "Bush, 2–3 feet. Flowers white." September 27–October 20, 1966. *Schultes, Raffauf et Soejarto 24285.*

Fresh material of this bush gives an alkaloid-negative result from a spot-test with Dragendorff reagent.

Loreya acutifolia *O. Berg ex Triana* in Trans. Linn. Soc. 28 (1871) 142.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Urania. "Tree, 60 feet. Flower buds yellow with deep pink top; stamens yellow; flowers showy." October 12, 1966. *Schultes, Raffauf et Soejarto 24417.*

A spot-test for alkaloids with Dragendorff reagent indicates that this collection is negative.

Miconia tomentosa *(L. C. Rich.) D. Don,* Mem. Wern. Soc. 4 (1823) 316, 750.

COLOMBIA: Comisaría del Amazonas, Leticia. "Tree 25 feet. Fruits red." August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24092.*

This collection was alkaloid-negative with a Dragendorff spot-test.

SAPOTACEAE

Chrysophyllum Cainito *Linnaeus,* Sp. Pl. (1753) 192.

COLOMBIA: Comisaría del Amazonas, Río Atacuari. "Small tree, diameter 6 inches. Bark rough. Flower buds open, pink. Latex only in leaves, white." October 24, 1946. *Schultes et Black 8578.*—Río Miritiparaná. "Small tree. Fruit brown. Latex white. Leaves rusty beneath." August 5, 1952. *Schultes et Cabrera 16414.*—Caño Aduche, near Araracuara, Río Caquetá. "Fruit edible." Februrary 27, 1982. *LaRotta 125.*

The Yukunas call this plant *kĕ-sĕ-wee'-ree;* in the Andoque language of the Río Caquetá, the name is reported to be *so-da-dí.*

The fruit of numerous species is edible. The Yukunas, however, value the latex of the plant as a cure for what appears to be a fungal infection of the crotch. The plant is commonly cultivated and is, consequently, easily available for treating this common complaint. The latex is applied over a period of several days to the infected area and allowed to dry.

Chrysophyllum sanguinolentum *(Pierre) Baehni* in Boissiera 11 (1965) 74.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Jinogojé. "Enormous tree. Latex white. Flowers cauline, yellow-green. June 15, 1952. *Schultes et Cabrera 16738.*

The latex of *Chrysophyllum sanguinolentum* is said to be efficaceous in hastening the heeling of open wounds. It is applied and allowed to dry, forming a kind of protective "skin." The Makuna name of the tree is *boo-a'-tee-go;* the nomadic Makú Indians of the Río Piraparaná known it as *werg-han'*.

Pouteria Caimito *(R. et P.) Radlkofer* in Sitzb. Math-Phys. Akad. Muench. 12 (1882) 333.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, Los Monos. September 24, 1978. *Pabón 575.*

The Witoto Indians, who know this plant as *jifi-icona,* macerate and toast the young leaves and apply the material to wounds as a disinfectant.

Pouteria Melinonii *(Engl.) Baehni* in Candollea 9 (1942) 200.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 1946. *Schultes et Black 8560.*

Amongst the Tikunas, a tea made from the bark is considered to be a strong purgative.

GENTIANACEAE

Chelonanthus alatus *(Aubl.) Pulle,* Enum. Pl. Surinam (1906) 376.

BRAZIL: Estado do Amazonas, Río Curicuriarí. March 12, 1978. *Damião 2962.*

The local name of this herb is *tabaco bravo,* suggesting its possible use as a substitute for *Nicotiana Tabacum.*

Chelonanthus chelonoides *(Linn. f.) Gilg* in Engler et Prantl, Natürl. Pflanzenfam. 4, 2 (1895) 98.

COLOMBIA: Comisaría del Vaupés, Río Macaya, Cerro Chiribiquete. July 24, 1943. *Schultes 5614.*

The powdered leaves are reputed to be an excellent insect repellent amongst the Indians of the upper Río Vaupés.

Chelonanthus uliginosus *(Griseb.) Gilg* in Engler et Prantl, Natürl. Pflanzenfam. 4, 2 (1895) 98.

COLOMBIA: Comisaría del Amazonas, Río Igaraparaná, La Chorrera. June 4–10, 1942. *Schultes 3928.*

The root of this herb is valued in the form of a tea amongst the Witotos as a cure for stomach discomfort.

Coutoubea ramosa *Aublet,* Hist. Pl. Guian. Franç. 1 (1775) 74, t. 28.

COLOMBIA: Comisaría del Caquetá. La Tagua. January 20, 1965. *Melandro s.n.*

According to popular belief in the Caquetá, "it is poisonous and kills animals that eat it in the pastures."

Pagaea recurva *(Benth.) Bentham et Hooker* fil., Gen. Pl. 2 (1876) 814.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, Cerro de La Pedrera (Cupatí). April 1944. *Schultes 5863.*

This is a rare plant, the first report of the species from Colombia. The genus has only six species in tropical South America.

The natives of La Pedrera collect it on the historically important Cerro Cupatí for use in preparing a tea for the treatment of "debilitating forgetfulness" in the elderly (Altsheimer's disease?). The tea, prepared from the whole plant, is extremely bitter; it is called locally in Spanish simply *hierba amarga.*

Tachia guianensis *Aublet,* Hist. Pl. Guian. Franç. 1 (1775) 75, t. 29.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, path between El Encanto and La Chorrera. May 31–June 2, 1942. *Schultes 3876.*

Comisaría del Vaupés, Río Apaporis, Jinogojé. June 13, 1951. *Schultes et Cabrera 12476;* November 27, 1951, *Schultes et Cabrera 14670;* May 1952, *Schultes et Cabrera 19883.*

This is the first report of *Tachia guianensis* from Colombia.

The Witoto Indians of the Río Karaparaná add the powdered leaves to the coca preparation "to make it taste better." In the Río Apaporis, the natives state that there is no better remedy for "sore stomach" than a tea of the root of *Tachia guianensis.*

Styracaceae

Styrax Tessmannii *Perkins* in Notizbl. 10 (1928) 459.

Colombia: Comisaría del Amazonas, Río Loretoyacu. March 1946. *Schultes 7144.*

Comisaría del Vaupés, Miraflores, Río Vaupés. February 7, 1944. *Gutiérrez et Schultes 765.*—Caño Guaracú, Río Vaupés. February 21, 1944. *Gutiérrez et Schultes 868.*

The fragrant balsam from this tree is valued by medicine men of the Río Vaupés in their magical practices. The Tikunas of the Río Loretoyacu employ the resin to calm painful dental caries, packing the resin, softened by gentle heating, firmly into the decaying portion of the tooth.

Apocynaceae

Bonafousia tetrastachya*(HBK.) Markgraf* in Pulle, Fl. Surinam 4 (1937) 454.

Colombia: Comisaría del Amazonas, Río Loretoyacu. October 1945. *Schultes 6594.*—Same locality. September 1946. *Schultes et Black 8346.*—Mouth of Río Loretoyacu. October 8, 1961. *Idrobo 4692.*—Same locality. August 19, 1964. *Fernández-Pérez 6867.*

Locally known as *sanango* and *aji de monte,* this bush has numerous medicinal applications in the region, notwithstanding the caustic character of its latex.

The collection *Fernández-Pérez 6867* is very strongly alkaloid-positive with a Dragendorff spot-test on fresh material.

Malouetia furfuracea *Bentham ex Mueller-Argoviensis* in Martius, Fl. Bras. 6, pt. 1 (1860) 93.

Colombia: Comisaría del Vaupés, Mitú. "Small tree in water at river's edge. Flowers white. Latex white, abundant." September 27–October 20, 1966. *Schultes et Raffauf 24167.*

A Dragendorff reagent spot-test on fresh material gave the following results: bark strongly alkaloid-positive; leaves weakly positive.

Malouetia Tamaquarina *A. DeCandolle* in DeCandolle, Prodr. 8 (1844) 378.

Colombia: Comisaría del Amazonas, Río Loretoyacu. September-November,

1944. *Schultes 6034; 6083; 6112.*—Same locality. August 19, 1964. *Fernández-Pérez 6865.*

Comisaría del Vaupés, Río Kuduyarí, Yapobodá. October 1951. *Schultes et Cabrera 14170.*—Río Vaupés, near Mitú. November 13, 1952. *Schultes et Cabrera 18417.*

The Indians of both of these Comisarías consider *Malouetia Tamaquarina* to be poisonous. The collection *Fernández-Pérez 6865* is very strongly alkaloid-positive when fresh material is spot-tested with Dragendorff reagent.

The common name of this tree in the Río Loretoyacu region is *cuchara-caspi.* In the Vaupés, the Kubeos call it *yau-wa-hau'-ka-kee.* The Puinaves know it as *pom-ka'.*

For a discussion of the curious belief in the Leticia area of the toxicity of this species (*Schultes 6034, 6083, 6112*) to dogs through the meat or bones of the pajuil bird (*Nothocrax urumutum* (Spix)), see Schultes: Bot. Mus. Leafl., Harvard Univ. 19 (1960) 123–124.

Mandevilla Steyermarkii *R. E. Woodson* in Fieldiana, Bot. 28, No. 3 (1953) 502.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Urania. "Extensive vine. Fruits brownish to black. Latex abundant." March 20, 1970. *Schultes et Cabrera 26045.*

According to Indian informants, this vine is considered to be poisonous.

Mesechites trifida *(Jacq.) Mueller-Argoviensis* in Martius, Fl. Bras. 6, pt. 1 (1860) 151.

COLOMBIA: Comisaría del Vaupés Río Apaporis, Raudal de Jerijerimo. February 27, 1952. *Schultes et Cabrera 15687.*

The Makunas, who call this plant *mee-see'-man-gaw,* utilize the latex to cauterize and hasten the healing of recalcitrant sores and ulcers.

LOGANIACEAE

Spigelia anthelminia *Linnaeus,* Sp. Pl. (1753) 149.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, Caño Anduche. February 25, 1982. *La Rotta 113.*

An infusion of the root is used by the Andoque Indians as a tranquilizer for children. The Andoques call this plant *to-je-de'* (La Rotta: loc. cit. 55).

Strychnos guianensis *Thonning ex Didricksen* in Kjoeb. Vidensk. Meddel. (1854) 190.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Nuevo Granada. July 29, 1957. *Idrobo 2633.*

The Siona call this species *ya-hi'-ae-o* and employ it in preparing one of their curares.

Strychnos Mitscherlichii *Richard Schomburgk,* Fauna Fl. Brit. Gui.

COLOMBIA: Comisaría del Putumayo, Río Putumayo, Nuevo Granada. June 29, 1957. *Idrobo 2632.*

According to the collector's notes, the bark of this vine is rasped to prepare a poison that will "kill all animals." It is very bitter and exudes a "red resin." The Siona Indians call the plant *ya-yu'-ae-o* ("strong poison").

Strychnos panurensis *Sprague et Sandwith* in Kew Bull. (1927) 132.

COLOMBIA: Comisaría del Vaupés, Mitú. "Extensive vine on river's edge. Flowers fragrant, white. Fruit green. September 27–October 20, 1966. *Schultes et Raffauf 24166.*

A Dragendorff spot-test for alkaloids gave the following results on fresh material: fruit—strongly positive; bark and leaves—weakly positive.

SOLANACEAE

Cestrum ochraceum *Francey* var. **macrophyllum** *Francey* in Candollea 6 (1935) 344.

COLOMBIA: Comisaría del Putumayo, Sibundoy. May 29, 1946. *Schultes et Villarreal 7658.*—Same locality, April 12, 1963. *Bristol 750.*—Same locality. "Tree 5 m. Strong narcotic odour. Corolla cream to purplish brown. Fruit black, 8 mm. long. November 11, 1968. *Plowman 2006.*

In Sibundoy, the natives state that the whole plant is poisonous. The vernacular name is *sauco blanco.*

Solanum apaporanum *R. E. Schultes* in Bot. Mus. Leafl., Harvard Univ. 13 (1949) 292.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Mitú, near mouth of Río Kuduyarí. "Vine with spines. Flowers white. Fruit orange." October 6, 1966. *Schultes, Raffauf et Soejarto 24300.*

With a Dragendorff spot-test, this vine is alkaloid-positive.

Solanum jamaicense *Miller,* Gard. Dict., ed. 8, *Solanum* No. 17 No. 17 (1768).

COLOMBIA: Comisaría del Amazonas, Loretoyacu. "Shrub. Flowers white." August 29–31, 1966. *Schultes et Raffauf 24098.*

A Dragendorff spot-test on the leaves of this plant gave a doubtfully positive alkaloid reaction.

Solanum mammosum *Linnaeus,* Sp. Pl. (1753) 187.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, El Encanto. May 22–28, 1942. *Schultes 3808.*

Comisaría del Putumayo, Río Putumayo, Puerto Ospina. 3–25, 1942. *Schultes 3450.*—Río Sucumbios, Conejo. "Flowers purple; anthers yellow." April 2–5, 1942. *Schultes 3651.*

This plant is cultivated widely in the Putumayo, where it is called *tetilla* in Spanish, *koo-koo'-na* in Kofán. The bright yellow or orange fruits are placed in the rafters of the houses to alienate cockroaches.

BIGNONIACEAE

Distictella pulverulenta *Sandwith* in Brittonia 3 (1938) 91.

COLOMBIA: Comisaría del Amazonas, Río Popeyacá. "Vine. Flowers purplish, near base; calyx purple. February 22–26, 1952. *Schultes et Cabrera 15545.*

The Makuna Indians burn the leaves and mix the ashes with powdered coca (*Erythroxylon Coca* var. *Ipadu*). The Makuna name *ka-hee-ee-ko-mee-see'-ma* means "vine for ashes of coca."

GESNERIACEAE

Alloplectus semicordatus *Poeppig et Endlicher,* Nov. Gen. et Sp. 3 (1845) 5.

COLOMBIA: Comisaría del Amazonas, Río Karaparaná, El Encanto. "Bracts bright red. Flowers yellow." May 22 28, 1942. *Schultes 3855.*—Río Caquetá, La Pedrera. "Epiphyte. Bracts rec." April 1944. *Schultes 5872.*—Río Loretoyacu. *Glenboski 1.*

Comisaría del Vaupés, Cerro Chiribiquete. May 15–16, 1943. *Schultes 5490.*

The Tikunas in the Río Loretoyacu crush the leaves and rub the juice on rheumatic joints to ease the pain. In La Pedrera, the natives drink an infusion of the leaves to "purify the blood."

Besleria ignea *Fritsch* in Notitzbl. 11 (1934) 966.

COLOMBIA: Comisaría del Amazonas, Río Caquetá, La Pedrera. "Flowers brick-red." April 1944. *Schultes 5885.*

The natives of La Pedrera consider that the leaves of this epiphyte when ingested are a strong purgative.

Besleria leucostoma *(Hook.) Hanstein* in Linnaea 34 (1865–66) 326.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. *Glenboski 249.*

The common name of this epiphyte indicates its use amongst the Tikunas: *mata de conga;* leaves are crushed and applied as a plaster to the painful bites of the conga ant (Glenboski, loc. cit., 43).

Codonanthe Uleana *Fritsch* in Karsten et Schenck, Vegetationis - bilder 3 (1905) sub tt. 3–4.

COLOMBIA: Comisaría del Amazonas, Río Boiauassú. "Flower pink. Epiphyte." November 1945. *Schultes 6861.*

A plaster of the leaves of *Codonanthe Uleana* is applied to recalcitrant wounds and infections by the Tikunas who know this epiphyte as *ke-na'-tě-pa.*

It is interesting that the Waika Indians of Venezuela employ the root of *Codonanthe calcarata* Hanstein to "cure wounds" (von Reis et Lipp, p. 277).

Columnea villosissima *Mansfield* in Fedde Repert. 38 (1935) 26.

COLOMBIA: Comisaría del Putumayo, Mocoa. December 3–7, 1942. *Schultes et Smith 2063.*

A plaster of the fleshy leaves of *Columnes villosissima* is valued by the residents of Mocoa as a "sure cure" for the bite of the deadly bushmaster snake; the leaves are crushed and applied to the area of the bite.

ACANTHACEAE

Aphelandra pilosa *Leonard,* Contrib. U.S. Nat. Herb. 31 (1953) 200, t. 74.

COLOMBIA: Comisaría del Vaupés, Río Kuduyarí, Yapobodá. October 4–6, 1951. *Schultes et Cabrera 14268.*—Río Vaupés, Circasia. November 1951. *Schultes et Cabrera 19633.*

The local inhabitants of the Vaupés make a refreshing, stimulating tea from the leaves of *Aphelandra pilosa.*

Justicia chlorostachya *Leonard* in Contrib. U.S. Nat. Herb. 31 (1958) 498.

COLOMBIA: Comisaría del Vaupés, Río Apaporis, Soratama. June 20, 1951. *Schultes et Cabrera 12703.*

Amongst the Taiwanos of the Río Kananarí, the powdered aromatic leaves of *Justicia chlorostachya* are valued as an insect repellent. The powdered leaves are employed also to apply to rashes of fungal origin in the crotch.

Justicia comata *(L.) Lamarck,* Encycl. 3 (1789) 632.

COLOMBIA: Comisaría del Amazonas, Río Amacayacu. "Flowers white, purple spotted." September 1946. *Schultes 8248.*

The leaves of *Justicia comata* are dried, powdered and employed amongst the Tikunas as an insecticide or insect repellent.

Justicia peliantha *Leonard* in Contrib. U.S. Nat. Herb. 31 (1958) 591, t. 220.

COLOMBIA: Comisaría del Putumayo, Río Guamués, San Antonio. December 6, 1968. *Plowman 2109.*

This plant is known in the Putumayo as *cola de monte*. It is reputedly "medicinal", but no specific use could be elucidated.

Justicia stenophylla *Urban et Britton* in Urban, Symb. Ant. 7 (1912) 389.

COLOMBIA: Comisaría del Vaupés, Río Pacoa. February 7, 1952. *Schultes et Cabrera 15244.*

The Puinave name for this plant is *ya-ko-yoo'*.

Justicia sp.

COLOMBIA: Comisaría del Guainía, alto Río Inirida. October 11, 1978. *Espina 313.*

According to the collector, this collection is known as "flor de la culebra", suggesting that it may be employed in treating snake-bites.

Mendoncia pedunculata *Leonard* in Contrib. U.S. Nat. Herb. 31 (1951) 16.

COLOMBIA: Comisaría del Vaupés, Río Vaupés, Miraflores. February 12, 1944. *Gutriérrez et Schultes 789.*

The root of this plant, common in the uppermost Vaupés, is said to have been a favourite fish poison in former years.

Sanchezia Pennellii *Leonard* in Journ. Wash. Acad. Sci. 16 (1926) 488.

COLOMBIA: Comisaría del Amazonas, Río Amazonas, Leticia. September-November 1944. *Schultes 6164.*

The leaves of *Sanchezia Pennellii* are reported in Leticia to have excellent hemostatic properties.

It is perhaps significant that another species of *Sanchezia*—*S. thinophila*—is employed in the same region in the form of a wash to bathe the heads of girls who undergo the ritual adolescent initiating ceremony. (Schultes: Bot. Mus. Leafl., Harvard Univ. 26 (1978) 272).

Sanchezia thinophila *Leonard ex R. E. Schultes* in Bot. Leafl. Harvard Univ. 16 (1953) 94.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. October 20–30, 1945. *Schultes 6607*.—Puerto Nariño, near mouth of Río Loretoyacu. September 13–15, 1966. *Schultes, Raffauf et Soejarto 24121*.

The Tikunas of the Río Loretoyacu prepare a decoction of the inflorescences of *Sanchezia thinophila* to be used as a wash to bathe the heads of girls who undergo the tribal adolescent initiatory ceremony characteristic of these Indians. The hair is forcefully pulled out, leading to profuse bleeding. It is possible that this use is related to a kind of "Doctrine of Signature" connection with the large, showy, blood-red bracts of the plant.

Little is known of the chemistry of *Sanchezia*. The leaves of *Schultes, Raffauf et Soejarto 24121* proved to be alkaloid-negative with a Dragendorff reagent spot-test on fresh material.

RUBIACEAE

Isertia hypoleuca *Bentham* in Hooker, Journ. Bot. 3 (1841) 220.

COLOMBIA: Comisaría del Amazonas, Leticia. August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24002; 24041*.

Both of these collections produced positive alkaloid reactions with Dragendorff spot-tests. The local inhabitants report that a decoction of the leaves is rubbed on the chest to relieve pains.

Palicourea condensata *Standley* in Field Mus. Nat. Hist. Bot. Publ. 8 (1930) 224.

COLOMBIA: Comisaría del Amazonas, Leticia. "Tree 30 feet. Fruit green-black. Receptacle and axes purplish. August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24020*.

An alkaloid-positive reading was given by a Dragendorff spot-test on the leaves of this plant.

Palicourea crocea *(Sw.) Roemer et Schultes*, Syst. Veg. 5 (1819) 193.

COLOMBIA: Comisaría del Amazonas, Leticia. "Flowers bright yellow; axes orange. Fruit green. Scandent shrub." August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24023*.

The leaves of this shrub give an alkaloid-positive spot-test with Dragendorff reagent on fresh material.

Palicourea guianensis *Aublet,* Hist. Pl. Guian. Franç. 1 (1775) 173, t. 66.

COLOMBIA: Comisaría del Vaupés, Mitú. "Tree 25 feet. Flowers deep yellow; axes pale yellow." September 27–October 20, 1966. *Schultes et Raffauf 24195.*

Fresh leaf and stem material are strongly alkaloid-positive with a Dragendorff spot-test on fresh material.

Palicourea macrophylla *(HBK.) Standley* in Field Mus. Nat. Hist. Bot. Publ. 7 (1931) 321.

COLOMBIA: Comisaría del Amazonas, Leticia. "Tree 30 feet. Flowers violet to purple, very fleshy. On secondary growth." August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24011.*

Palicourea macrophylla is alkaloid-positive with a Dragendorff spot-test on fresh material.

Warscewiczia coccinea *(Vahl) Klotzsch* in Monatsb. Akad. Berlin. 1853 (1853) 497.

COLOMBIA: Comisaría del Amazonas, Leticia. "Small tree 15 feet. Flowers yellow. Bracts red." August 29–31, 1966. *Schultes, Raffauf, Forero et Soejarto 24096.*

This common and beautiful rubiaceous plant gives an alkaloid-negative response to a Dragendorff spot-test.

CAPRIFOLIACEAE

Sambucus mexicana *Presl ex DeCandolle,* Prodr. 4 (1830) 322.

COLOMBIA: Comisaría del Amazonas, Río Loretoyacu. September 2, 1972. *Glenboski 46.*

This cultivated plant is employed medicinally by the local people in the Río Loretoyacu: the leaves are boiled for half an hour, and the liquid is administered warm thrice daily in one-cup doses to treat measles and to "cool fevers" (Glenboski: loc. cit. 38).

The local name of this plant in Spanish is *sauco* or *sabuguera.*